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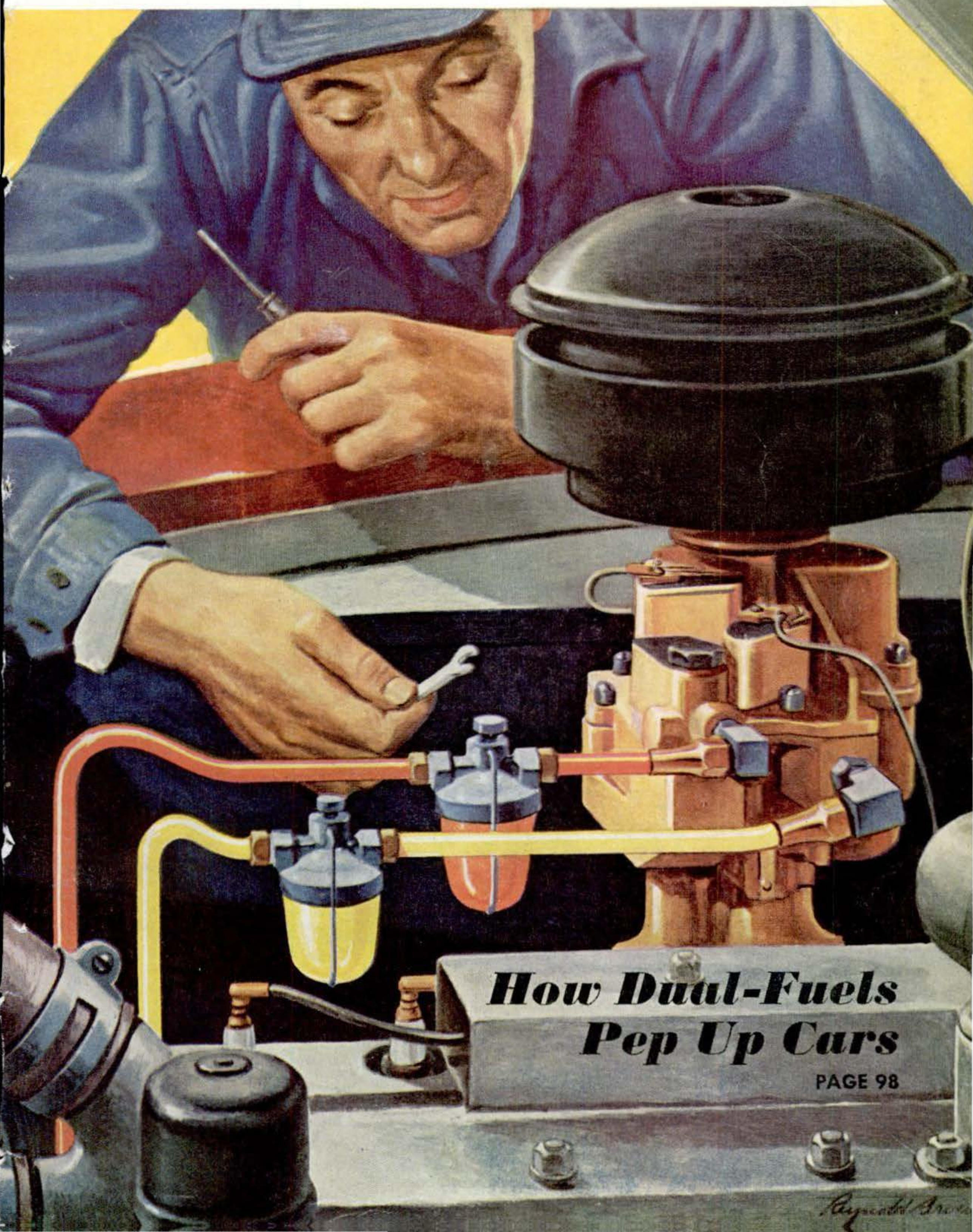

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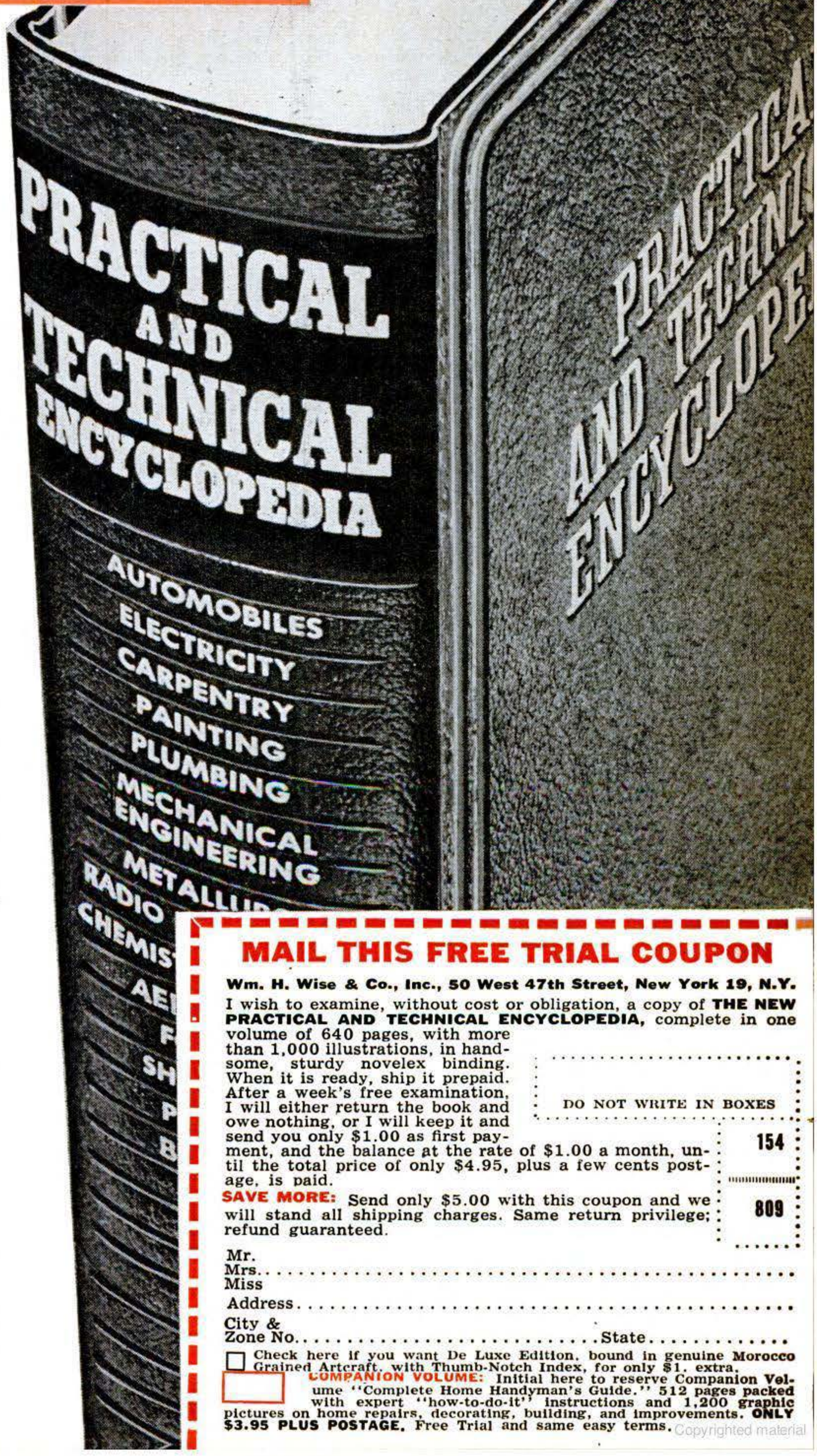

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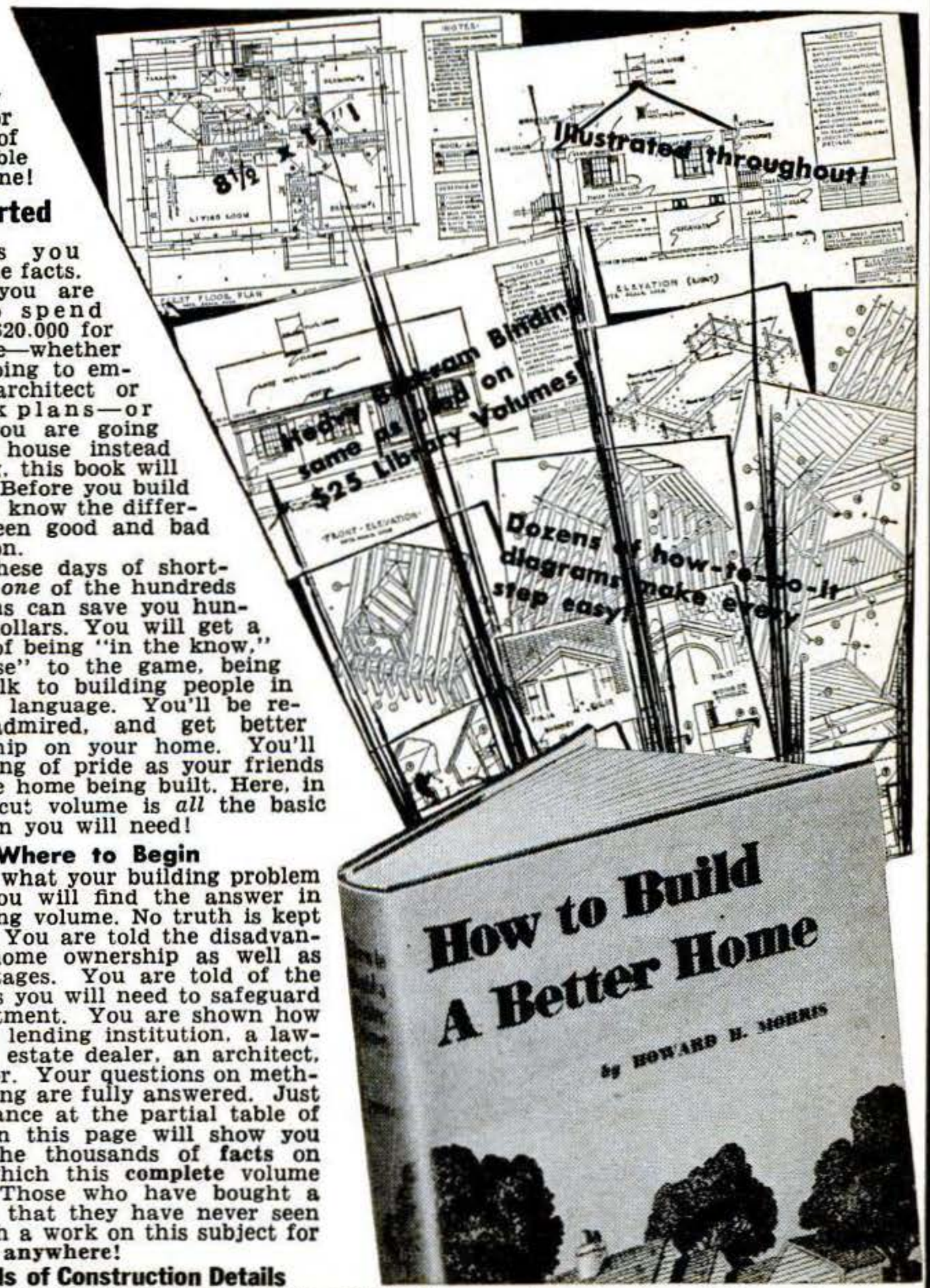

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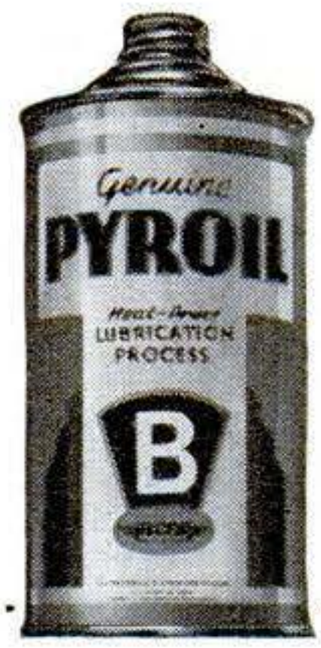

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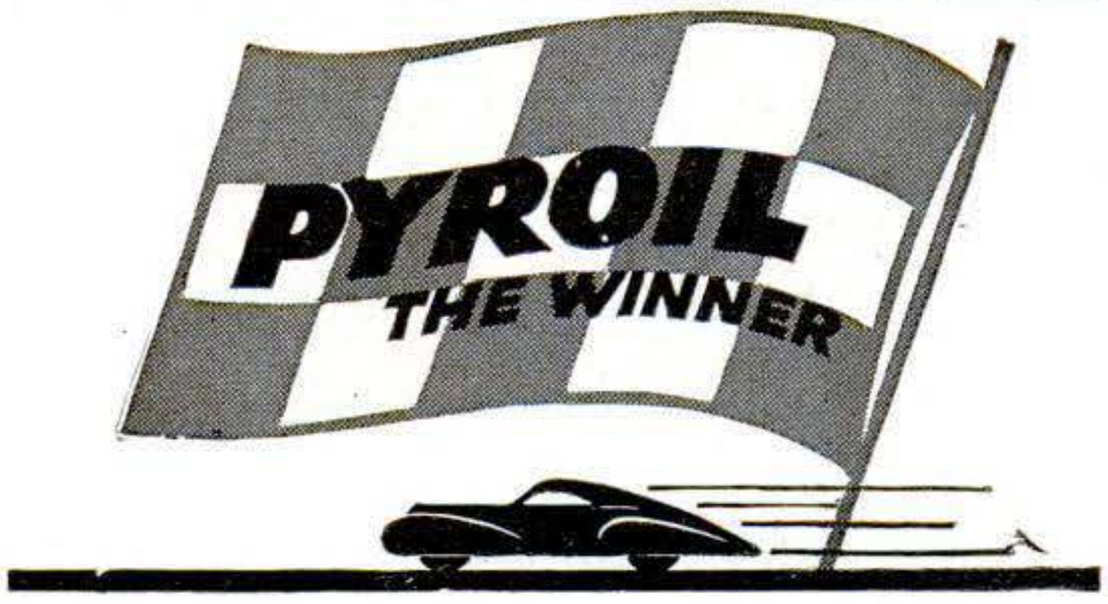

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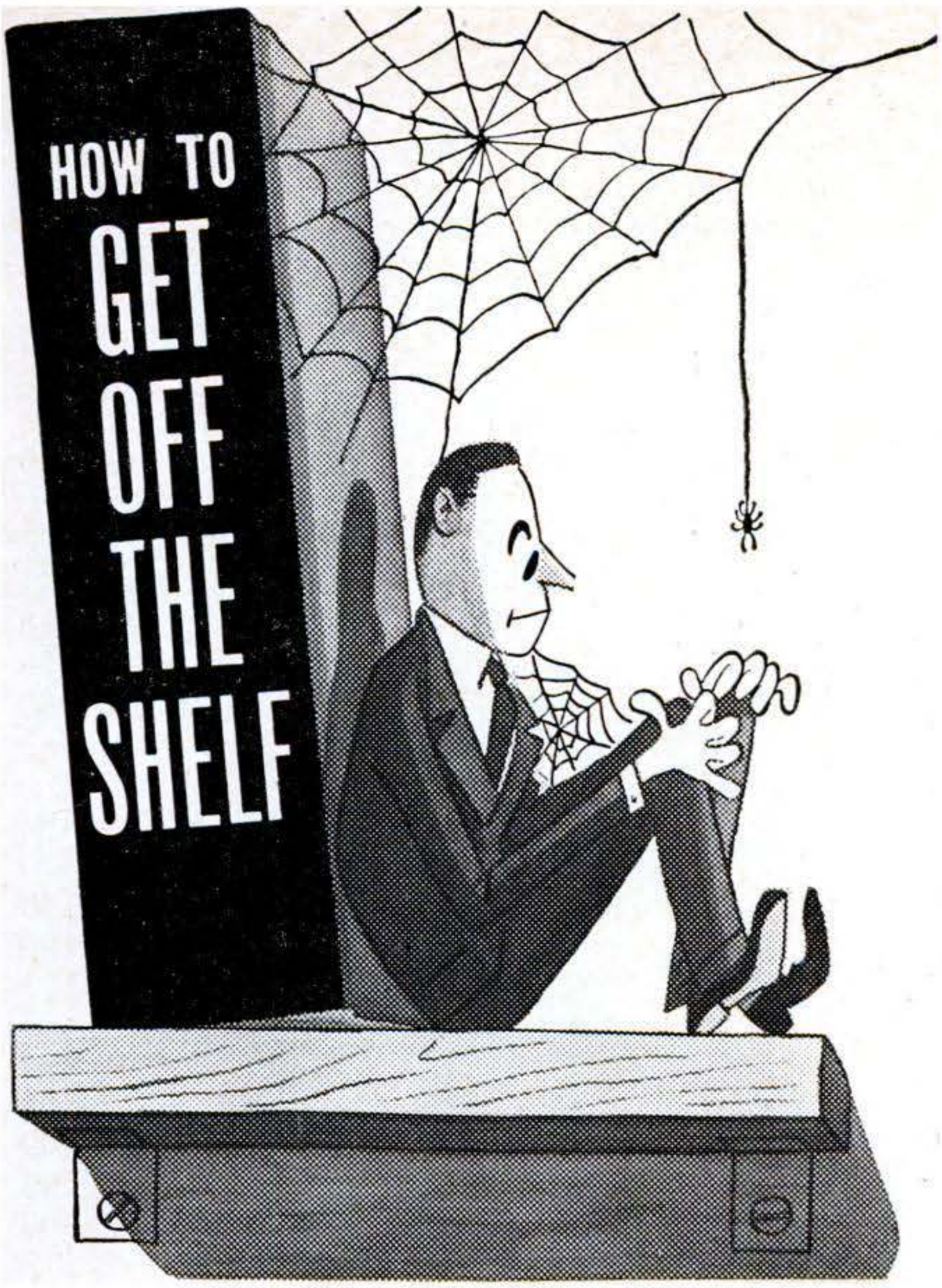

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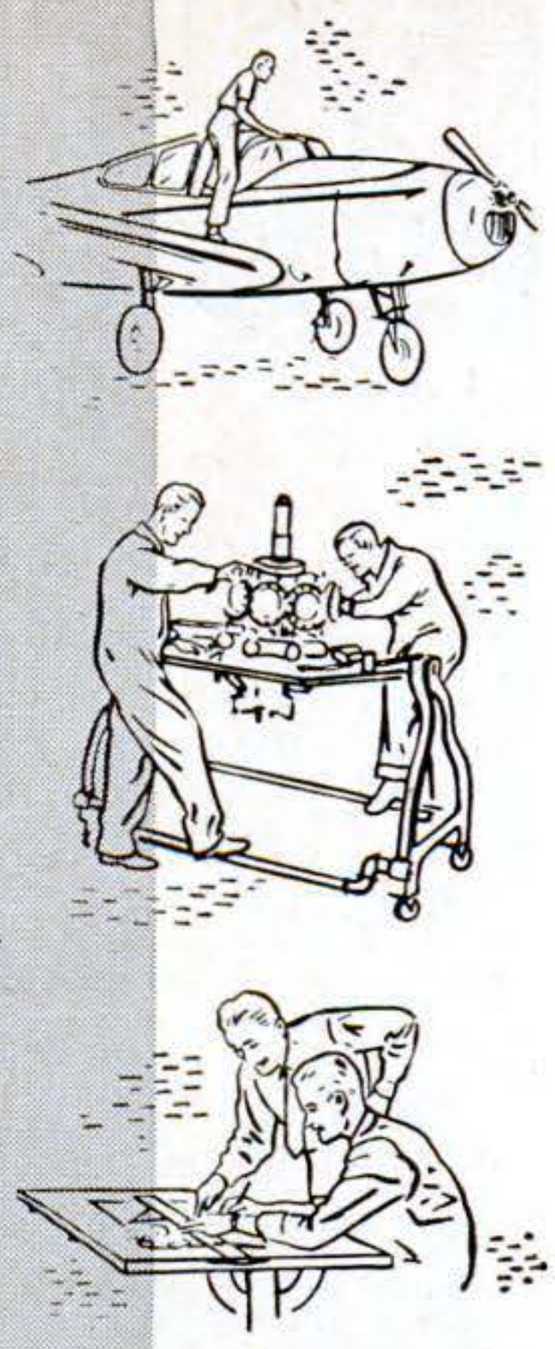

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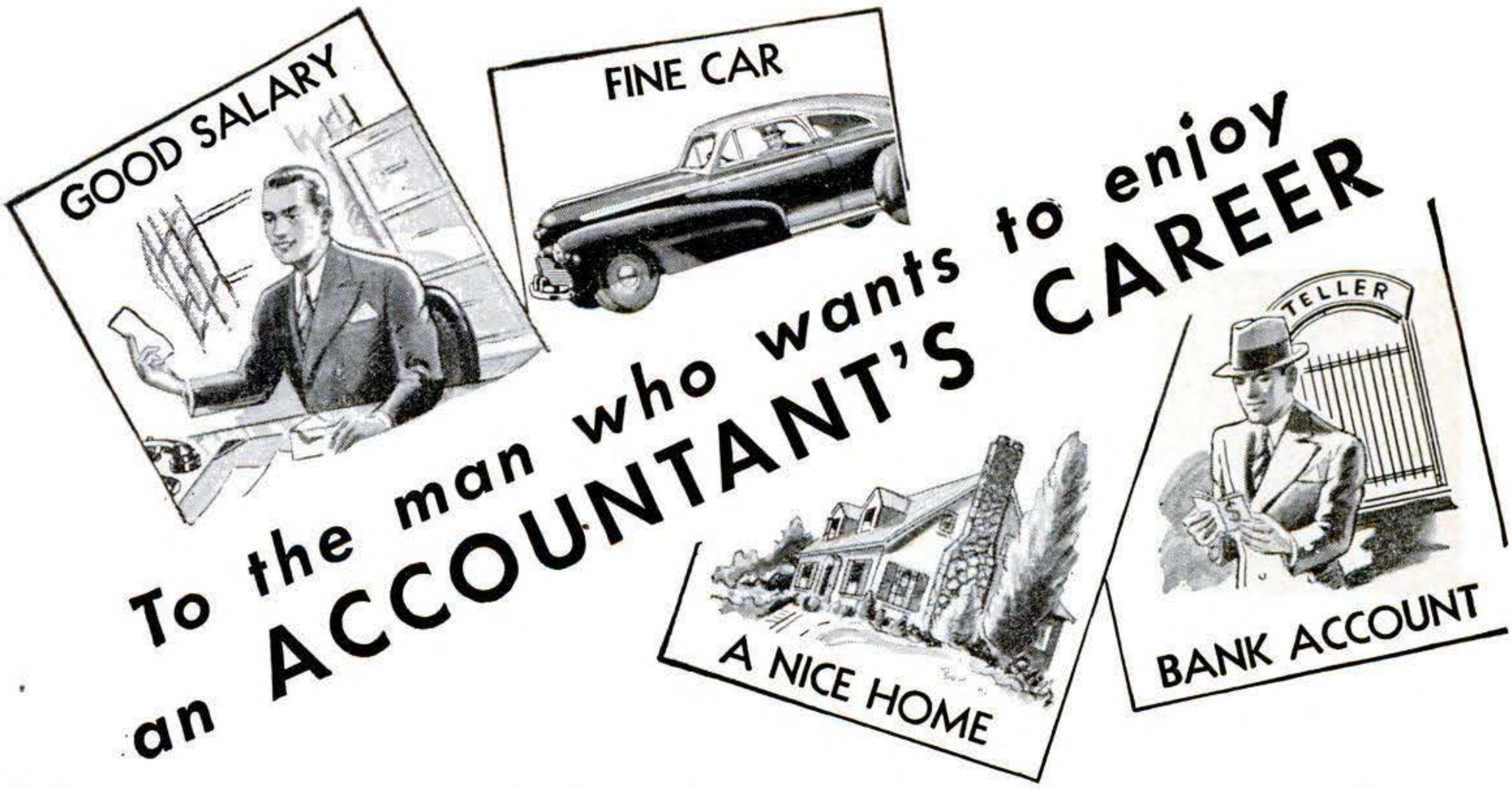

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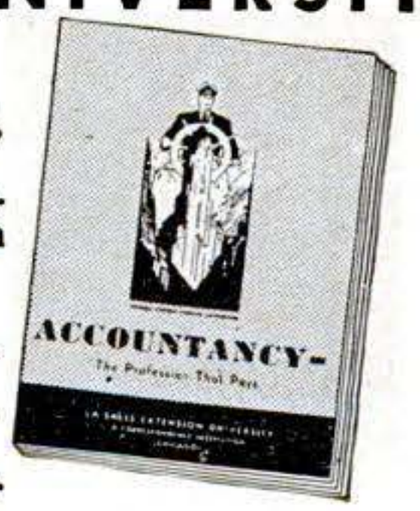

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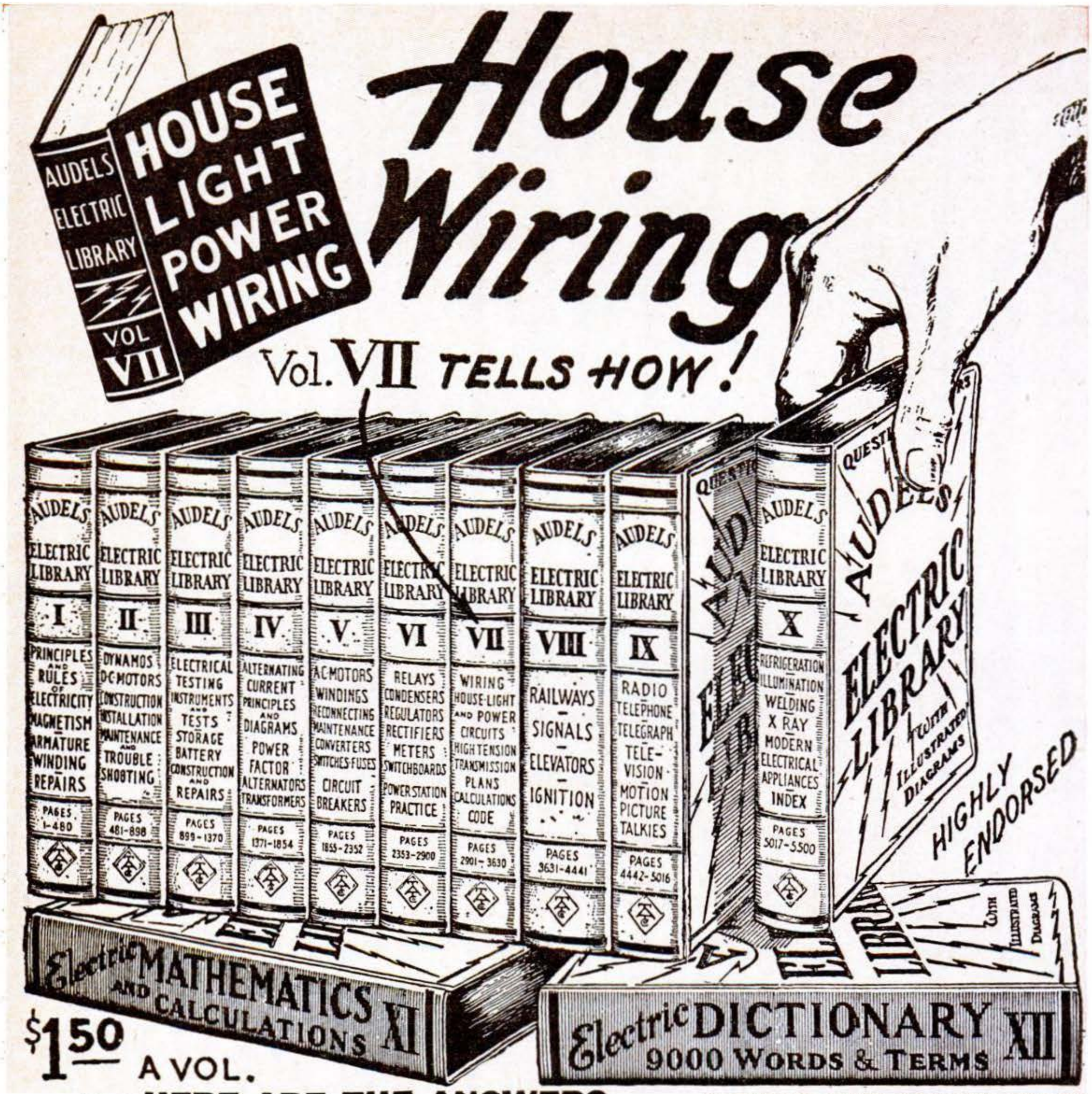

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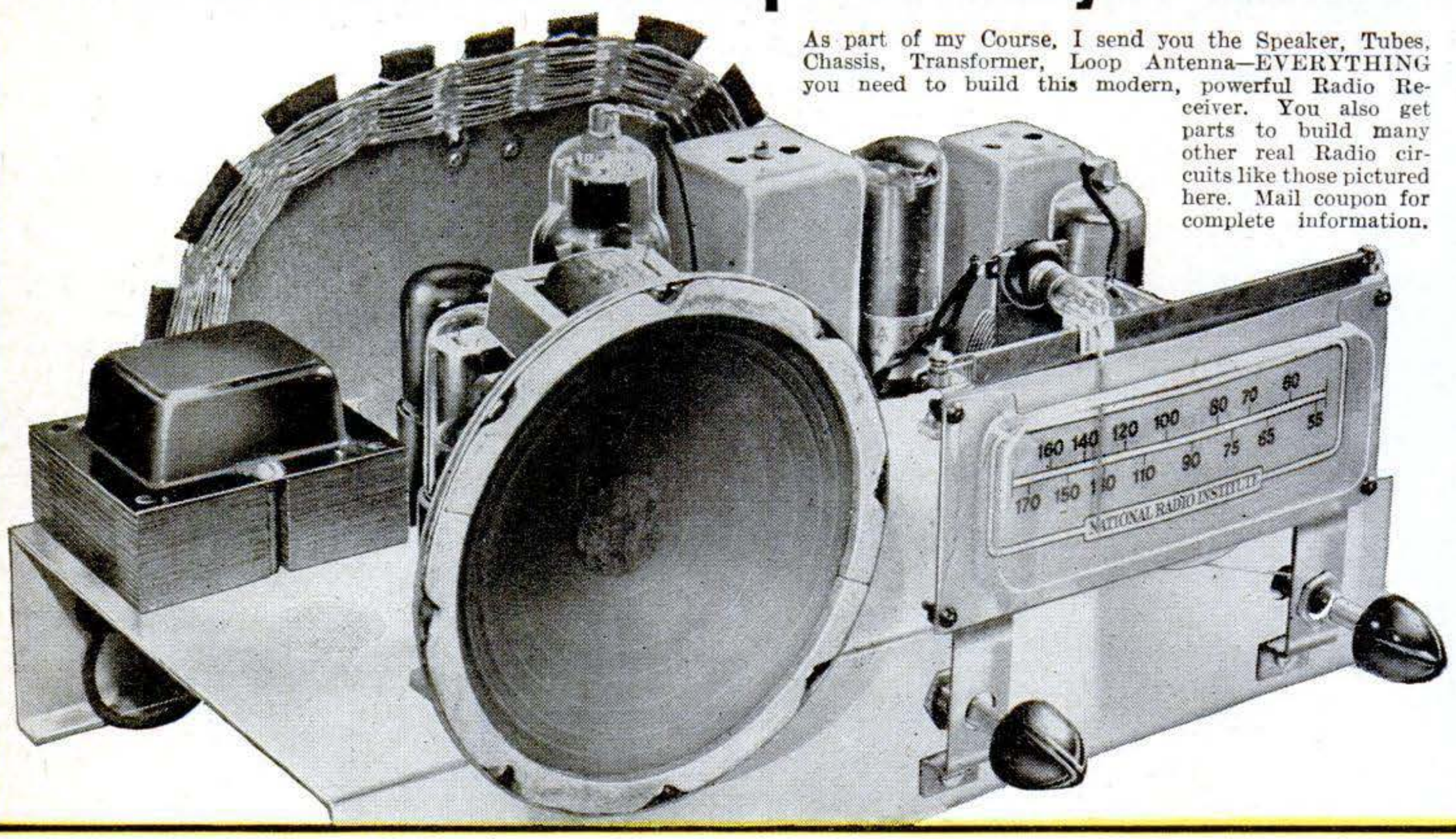

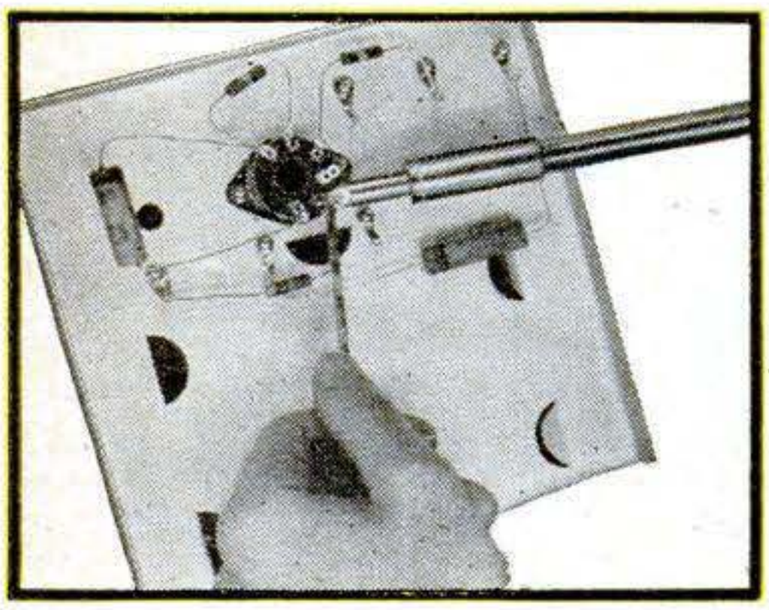

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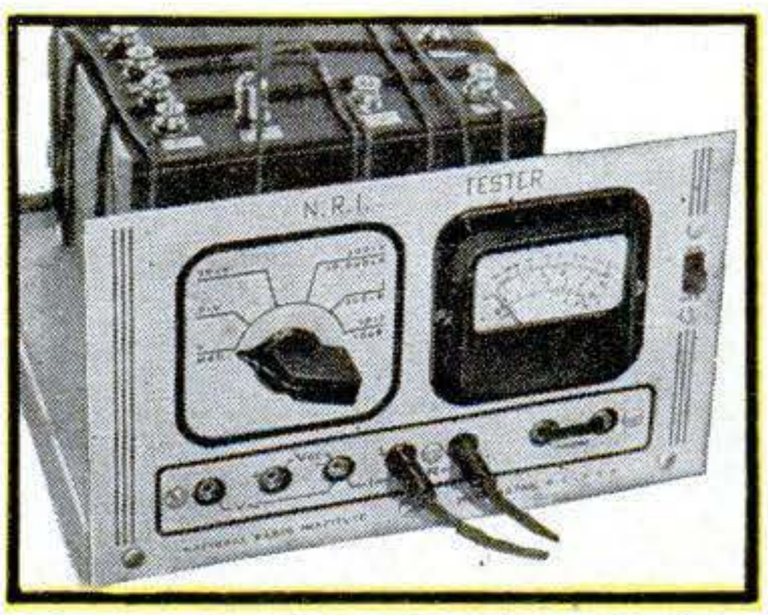

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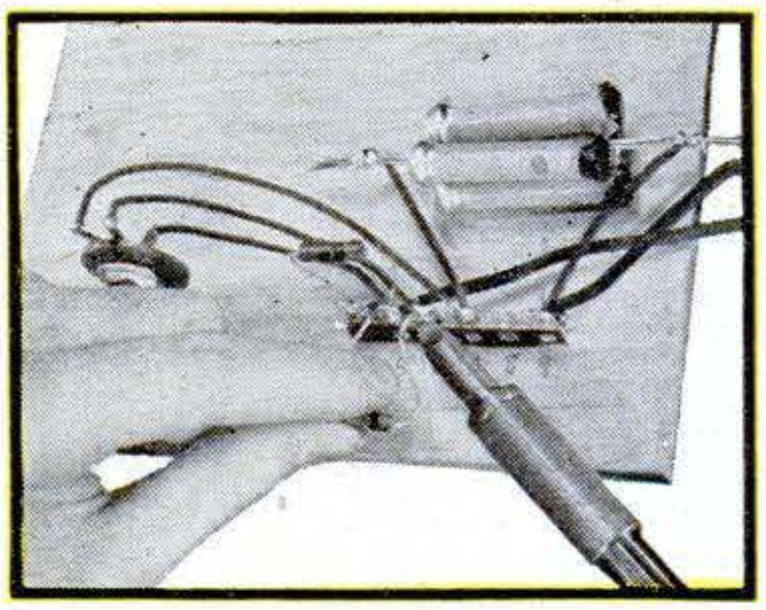

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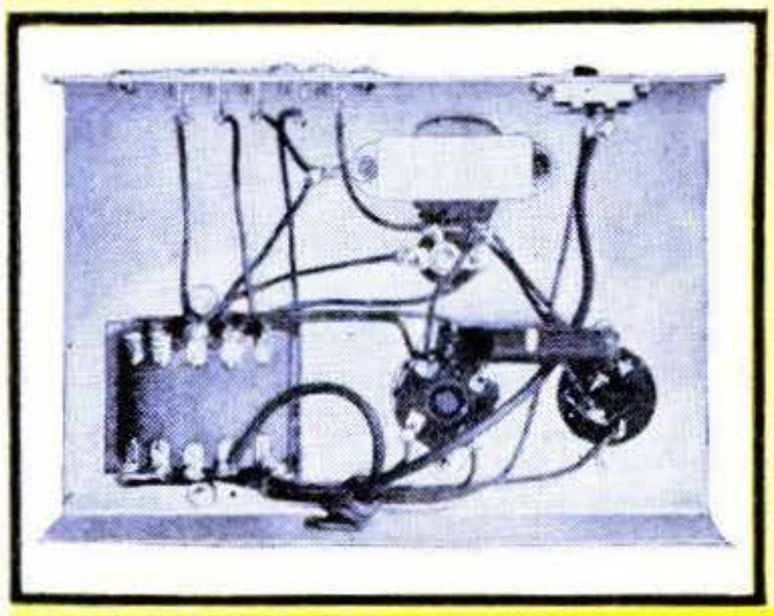

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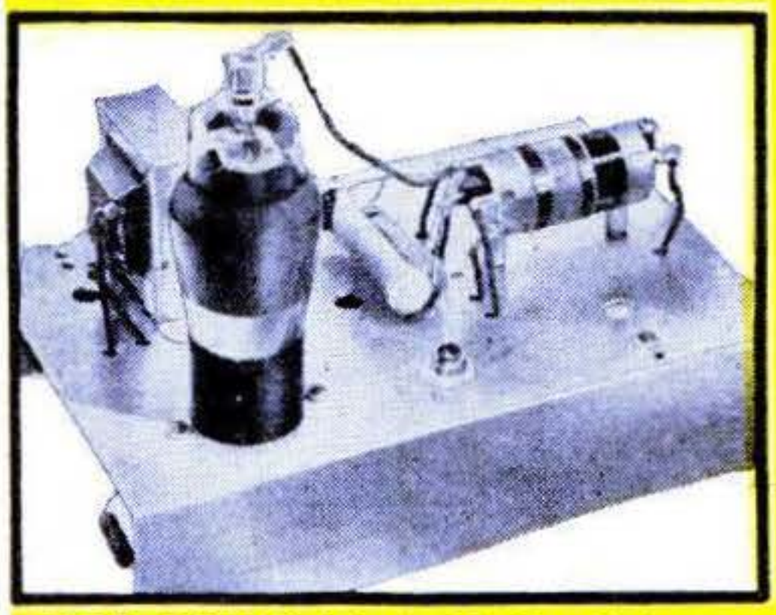

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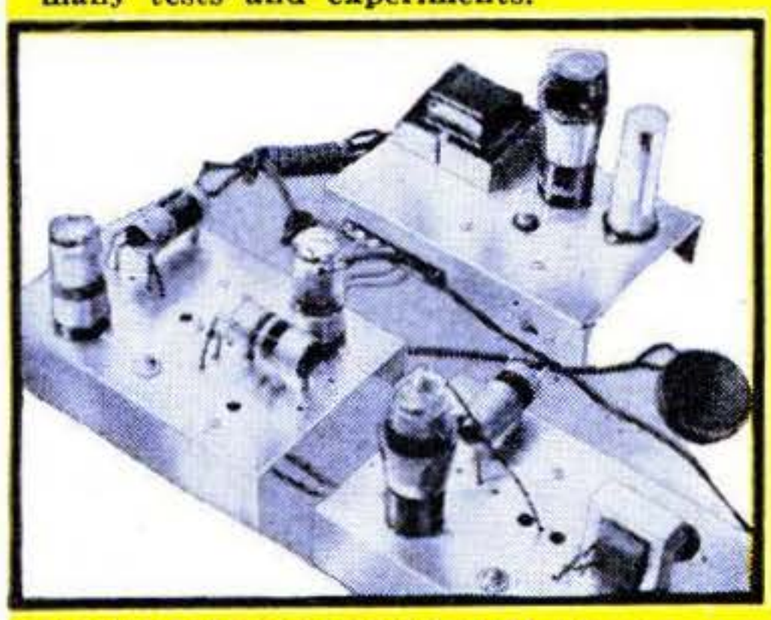

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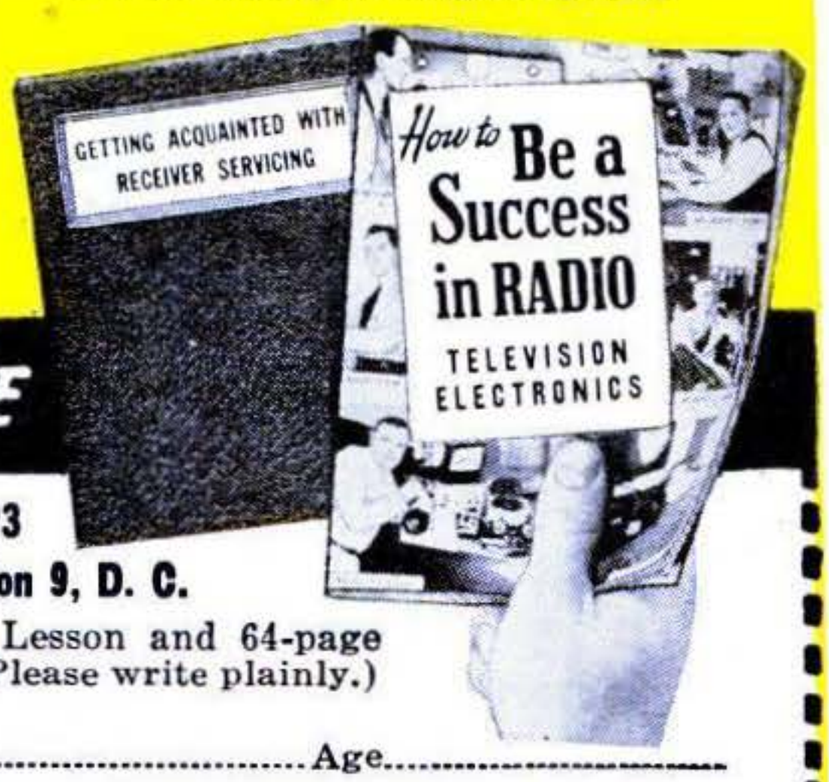

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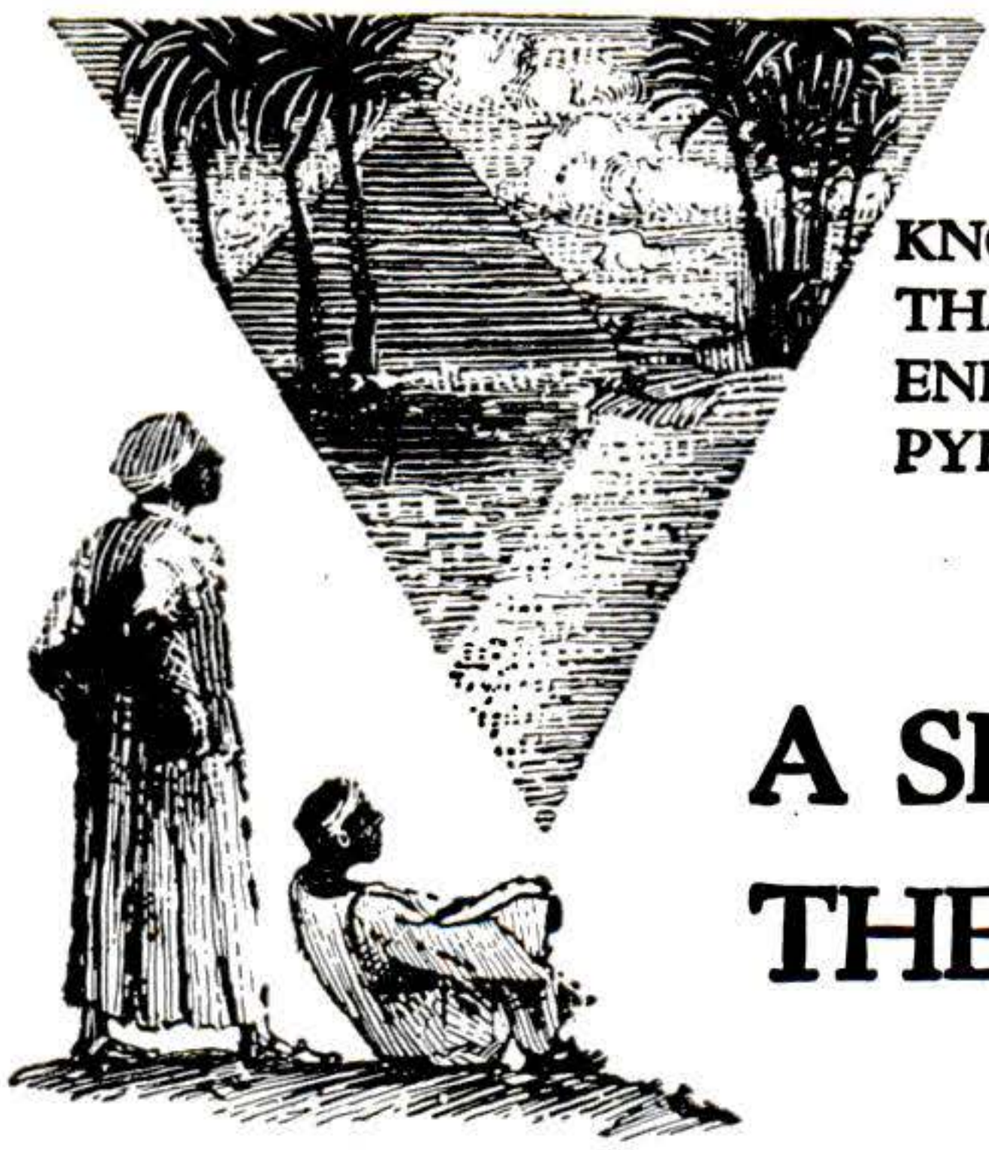

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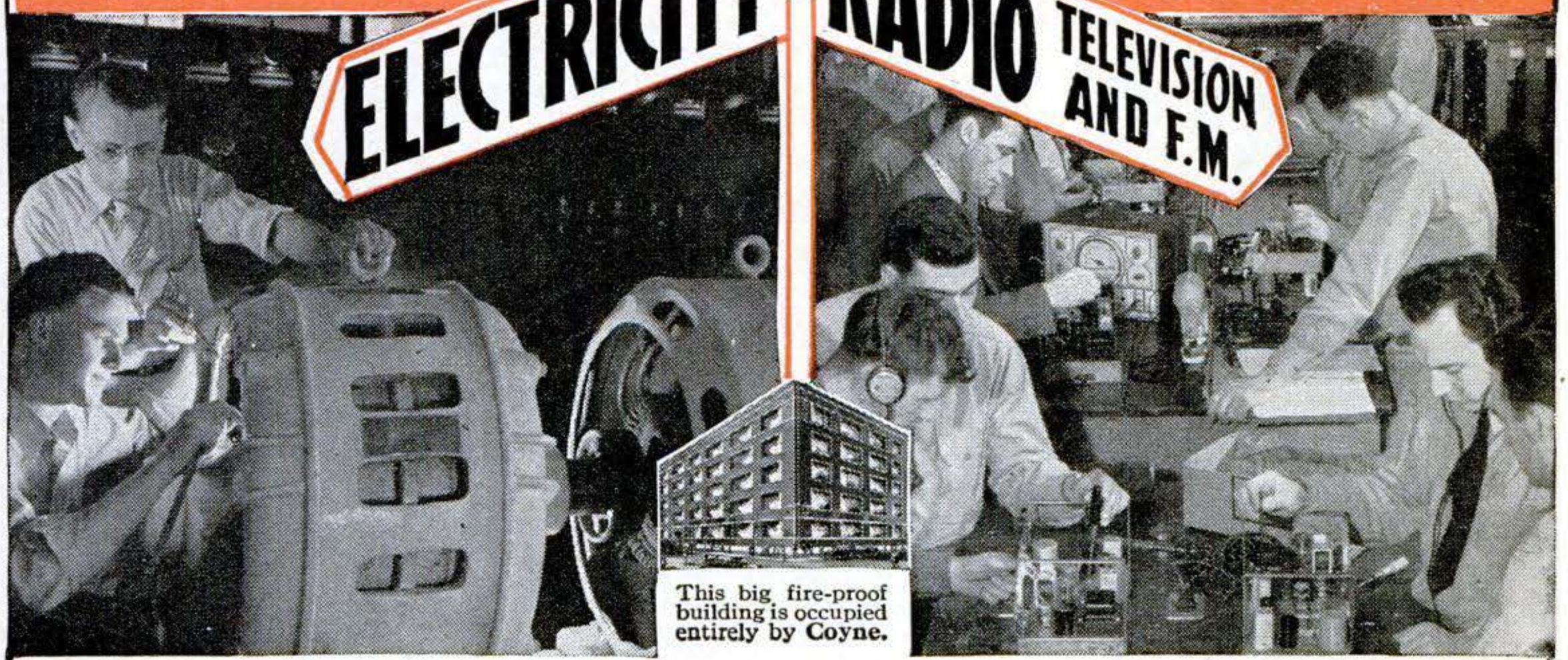

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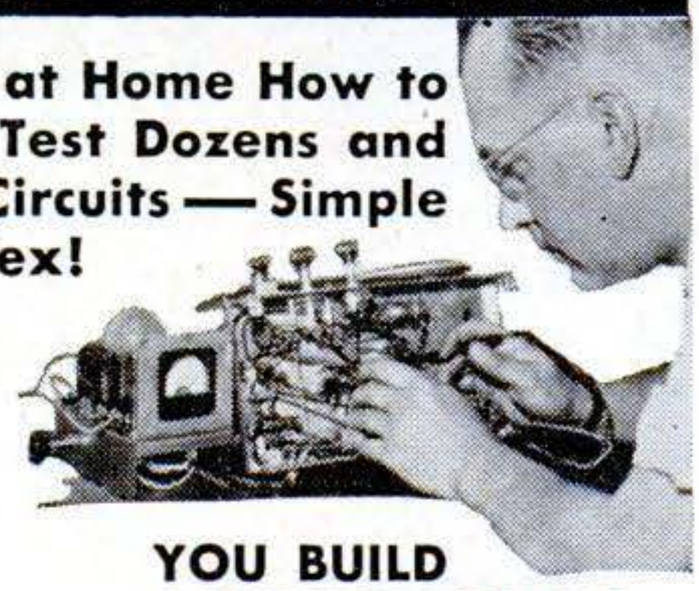

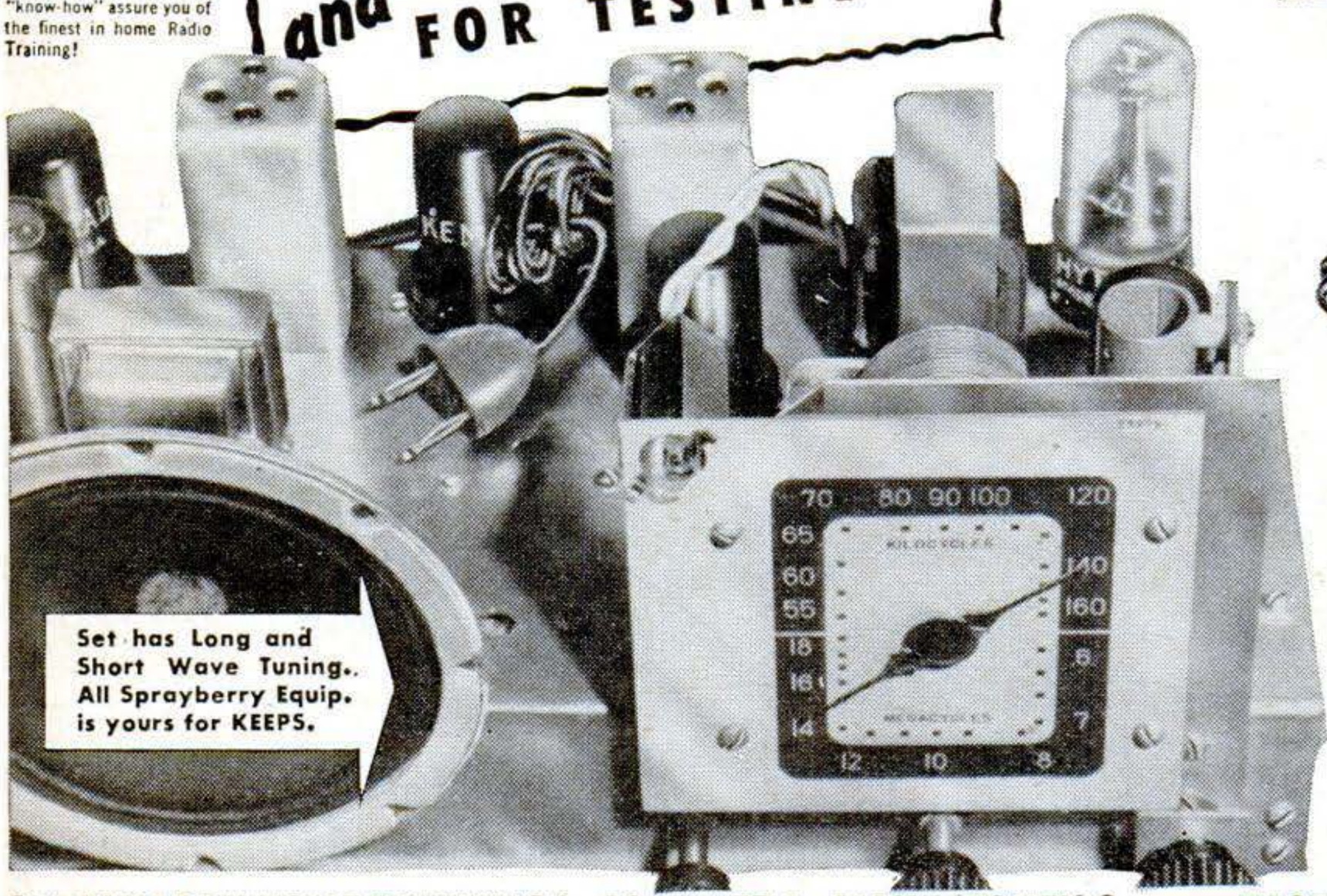

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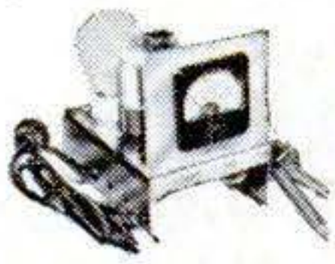
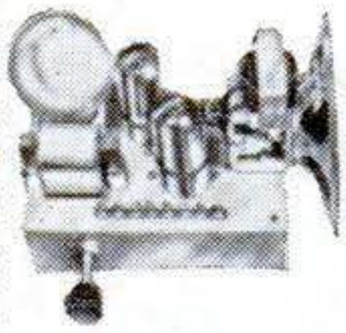
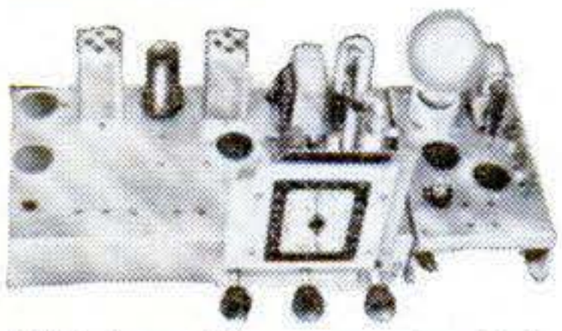


I give you a fine, moving-coil type Meter Instrument on Jewel Bearings — with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional speed and accuracy.



You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on ready-made Equipment.



Soldering, wiring, connecting Radio parts . . . building circuits with your own hands — you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

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I train you with regular professional Radio Equipment. I tell you exactly what to do . . . how to do it. You handle Radio Parts, see them operate, learn what they're for. With the fine Kits I supply, you learn how to build Radio Circuits, construct your own Test Equipment. I'll show you how to cause typical Radio defects so you can watch and see how they act. You learn the latest methods for trouble-shooting and repair. All this adds up to the finest kind of "bench" experience. And you get it right in your own home. In no time at all, you'll be ready for a business of your own or a good job in Radio, FM, Television, Radar, Industrial Electronics, etc. Now's the time to get started!

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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

The Patent Laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent, in order to comply with the requirements of the Patent Laws. For that reason, unless the inventor is familiar with patent matters, he should engage a competent registered patent attorney or agent to represent him. We are registered to practice before the U. S. Patent Office and are prepared to serve you in the handling of your patent matters.

A specially prepared booklet entitled "Patent Guide for the Inventor", containing detailed information with respect to patent protection and procedure, together with a "Record of Invention" form will be promptly forwarded to you without obligation upon request.

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Letters

Keep Right On Trying

Sir:

For the past few months, I have been trying to find a very technical mistake in your magazine, so that my letter might be with those printed in the magazine.

In the July, 1948 issue I found a mistake on page 86 ["The Inside Story of the New Ford"] in the picture on the lower right hand corner. The speedometer shows that the car has gone ½ mile. The gas gauge shows nothing, probably because the ignition is off. The oil is o.k. and the battery is o.k. . . . but the temperature shows the car as being extremely hot. How come?

WALLY HERMAN

Los Angeles, Calif.

This one shouldn't have fooled you. It's the same thing that happens in the Lincoln. When the ignition is turned off, the temperature-indicating needle falls over to the hot side of the gauge.

Condon—Pro and Con

Sir:

I want to congratulate you and PS for the editorial in the June issue. You are one of the few editors of popular literature in this country honest enough with yourself to warn the public of the dangers which free science faces today in the United States.

I am majoring in chemistry here at Lehigh and I had begun wondering if it were worthwhile continuing my studies, with American scientists, even those not engaged in secret work, being investigated and intimidated as they are today.

Your editorial, giving me evidence that all Americans are not blind to the danger, has given me new hope. Thanks again for a great editorial.

HENRY GATES

Bethlehem, Pa.

Sir:

The letter [Editorial, June '48, p. 71] in the current issue of PS isn't a very smart letter. It sounds very much like preorganization blather of a CIO drive and a *Daily Worker* editorial.

Because Condon is a Doctor of Science

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INVENTORS

Patent laws encourage the development of inventions.

We recommend that an inventor employ a registered Patent Attorney or agent, if the inventor is not familiar with patent matters. This is because the value of a patent depends largely upon the skillful preparation of the specification and claims in the patent application.

The firm of McMorrow, Berman and Davidson is registered to practice before the United States Patent Office. Additionally it engages patent attorneys able to readily understand inventors' disclosures, to advise concerning patentability, and to prepare appropriate specifications and claims.

If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

Send for a copy of Patent Booklet entitled "How To Protect Your Invention." This booklet contains information on patent protection and procedure. You will also receive an "Invention Record" blank. This will be promptly forwarded to you upon request—no obligation.

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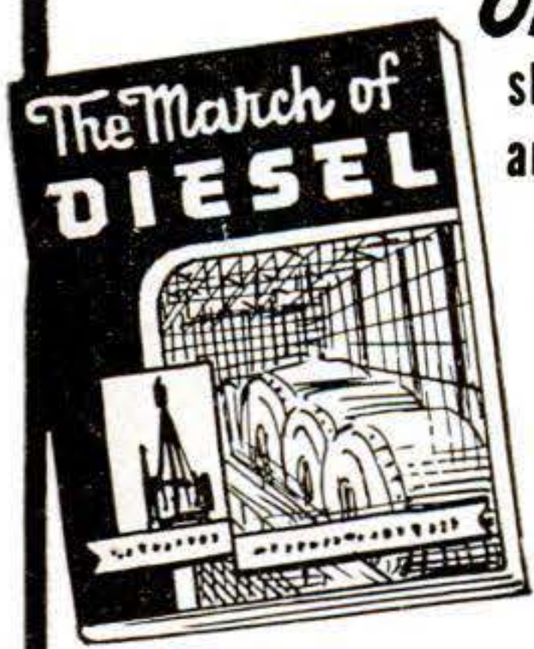

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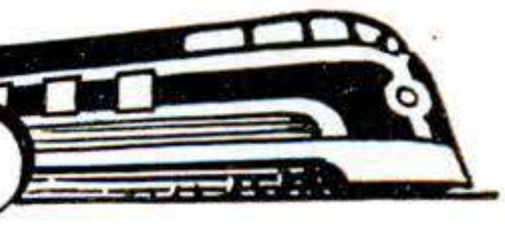

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doesn't make him sacrosanct and as a government employee who has, to be charitable, been indiscreet he should be investigated.

Just a little word of advice:

Don't let any well informed, non-scientific person hear you call the Condon investigation a smear or they will laugh in your face. . . .

ART BLUM

Waterford, N. Y.

The U. S. Atomic Energy Commission, after a new investigation of Dr. Condon under its security standards, has since described his loyalty as "unquestionable" and continued his clearance for handling restricted information on atomic research.

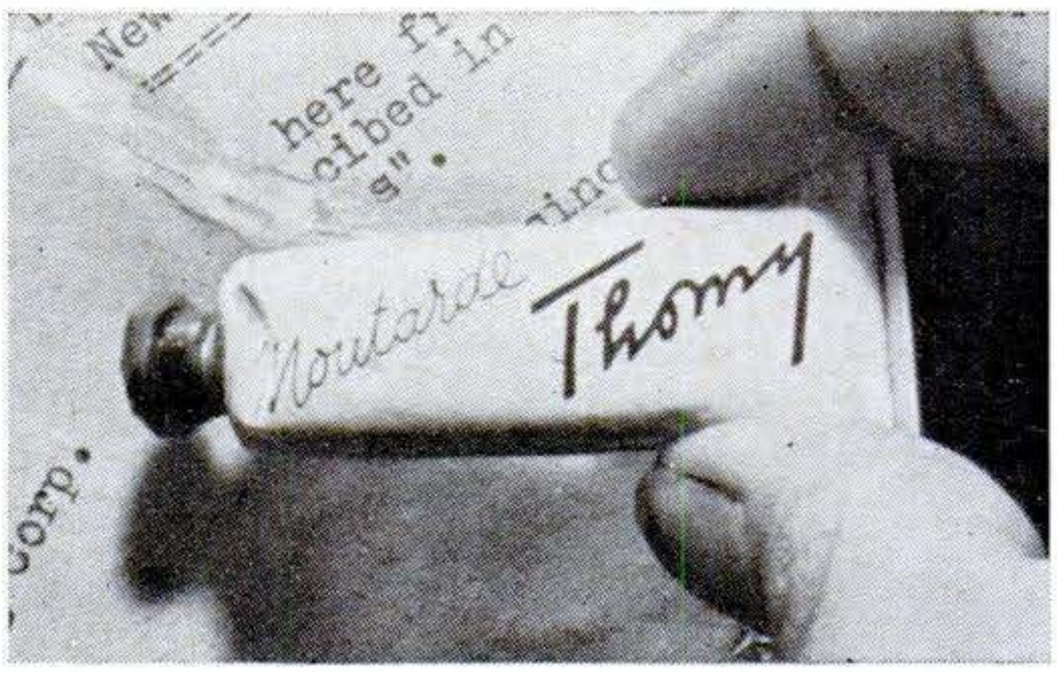
Answer from the Alps

Sir:

I take the liberty of sending you from here in Switzerland an example of mustard in a tube [shown below], described in Popular Science, April 1948, page 110 ["I'd like to See Them Make"] "Mustard in Tubes."

HUGO MARTHALER

Lucerne, Switzerland.



More About Cosmic Rays

Sir:

I am very intrigued by one part of your article "You Can't Escape Cosmic Rays" in the July issue. In the article you state that the neutrino is one of the two ultimate residual particles of a decayed meson. . . . When was this primordial particle discovered, by whom, who named it, and where can I obtain further information about it?

M. E. SHERMAN

Des Moines, Iowa

The neutrino was invented, rather than discovered, by W. Pauli, and named by Enrico Fermi. No one has ever seen or meas-

(Continued on page 22)

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INVENTORS

A patent is a valuable right. On the basis of a constitutional provision Congress has established a system under which inventors may secure the exclusive right to prevent the unauthorized use, manufacture and sale of their inventions for periods of seventeen years. The inventor secures this protection by obtaining a patent.

*U*nless an inventor is thoroughly familiar with such matters, he is advised to employ a competent registered patent attorney, as the value of patents depends largely upon the skillful preparation of the specification and claims.

*W*e recommend that you authorize us to conduct a search through the United States patents pertinent to your invention and to submit a report setting forth our opinion with respect to its patentability.

*T*his firm is registered to practice before the U. S. Patent Office and is available to assist inventors in the preparation and prosecution of their cases. Detailed information and the preliminary steps to take to obtain patent protection will be furnished upon request. *Form below for mailing convenience.*

VICTOR J. EVANS & CO. *Merlin M. Evans* REGISTERED PATENT ATTORNEY

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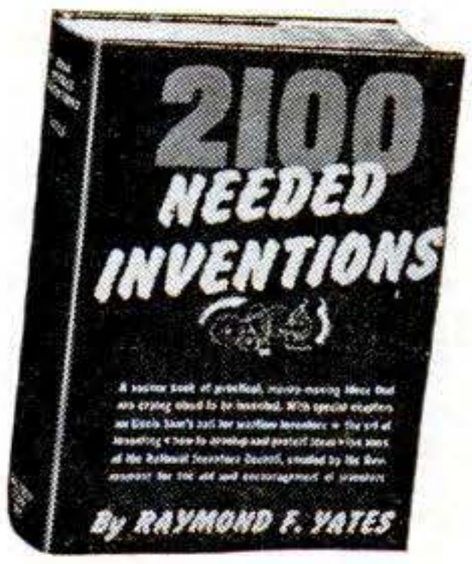

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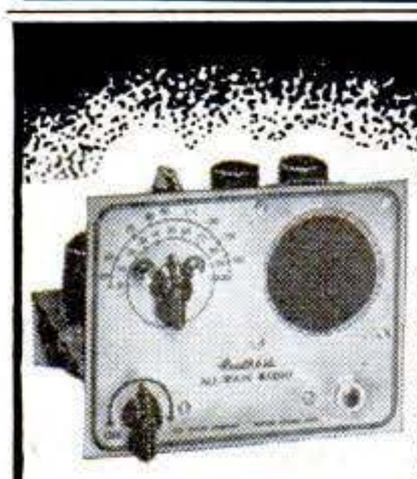

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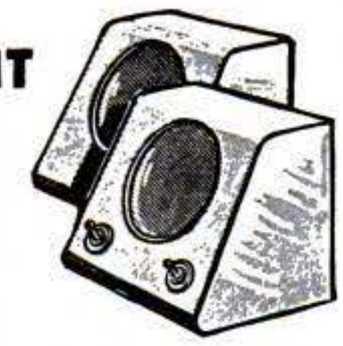

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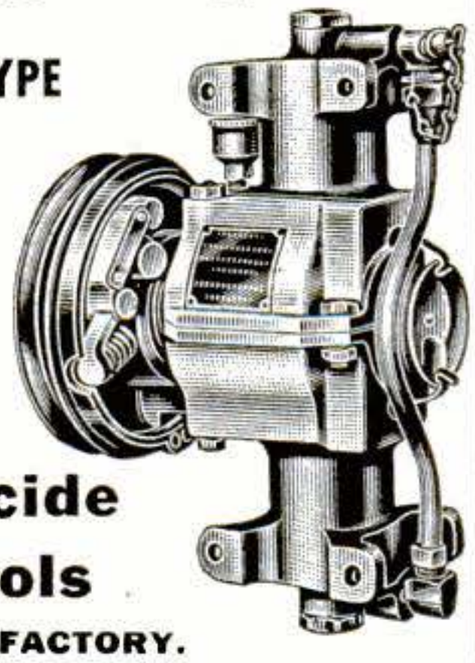

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ured a neutrino, but if it doesn't exist, something is apparently very wrong with the laws of conservation of energy and momentum. According to present theories, the neutrino is a very small particle, neutral in charge and weighing less than 1/20 as much as an electron. For further information see "Elementary Nuclear Theory" by H. A. Bethe (John Wiley & Sons, $2.50).

Sir:

I would like an explanation of the sentence that states, "The proton in the cloud chamber curves in the direction of positive charge. . . ." I was taught that "like charges repel and unlike charges attract."

NICK RESTAINO

Cresson, Pa.

The curved track a proton makes in a cloud chamber is caused by a magnetic field, not by other electric charges. The direction this track takes in the magnetic field indicates that the proton carries a positive electrical charge.

Sir:

I was led to believe that Einstein's quantum theory stated that photons were emitted from the shells of planetary electrons. However, you state that they come from the nucleus. Would you please inform me as to what the accepted theory is?

DONALD GLEASON

Brooklyn, N. Y.

"Photon" is a general name for the small unit, or package, of light energy and applies to all light regardless of its wave length or where it comes from. Photons of ordinary visible and ultraviolet light are emitted from the outer shell of planetary electrons. X-ray photons, of shorter wave length, come from the inner electron shells. Gamma-ray photons (those referred to in "You Can't Escape Cosmic Rays") have still shorter wave lengths and are emitted from the nucleus of the atom.

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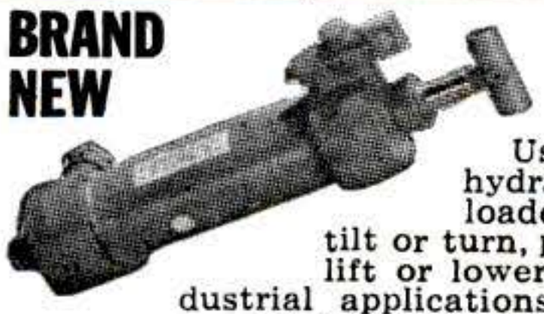

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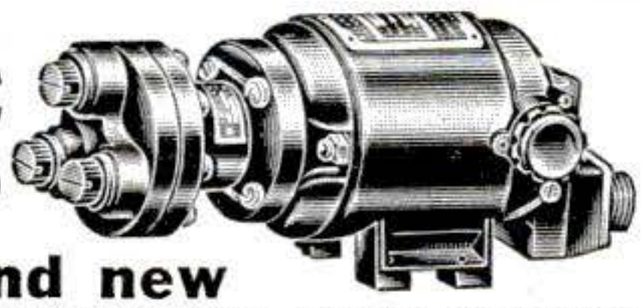

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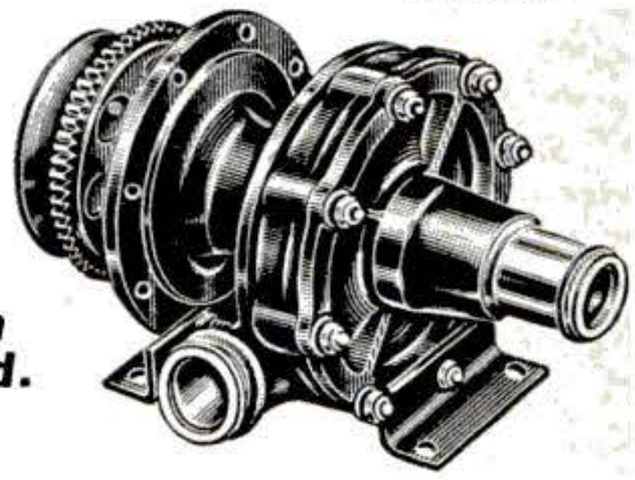

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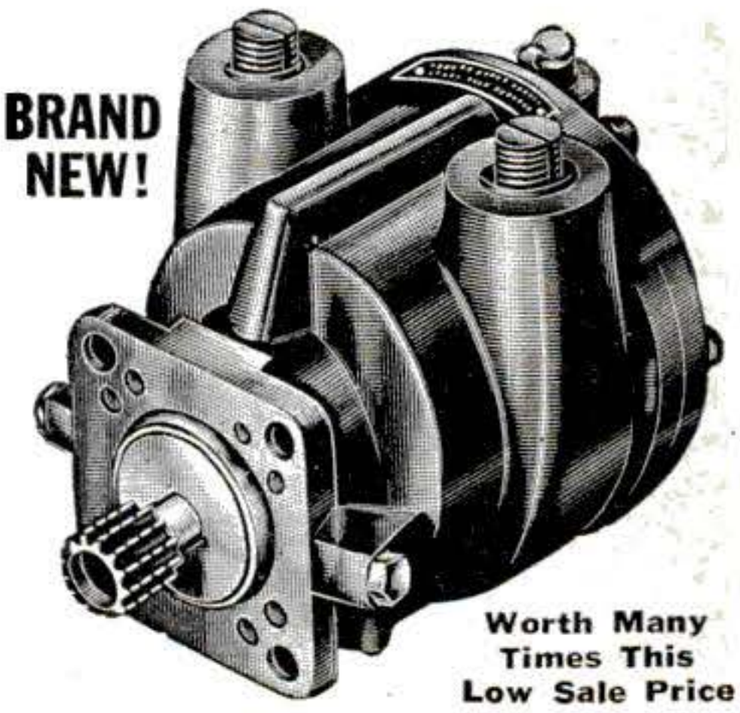

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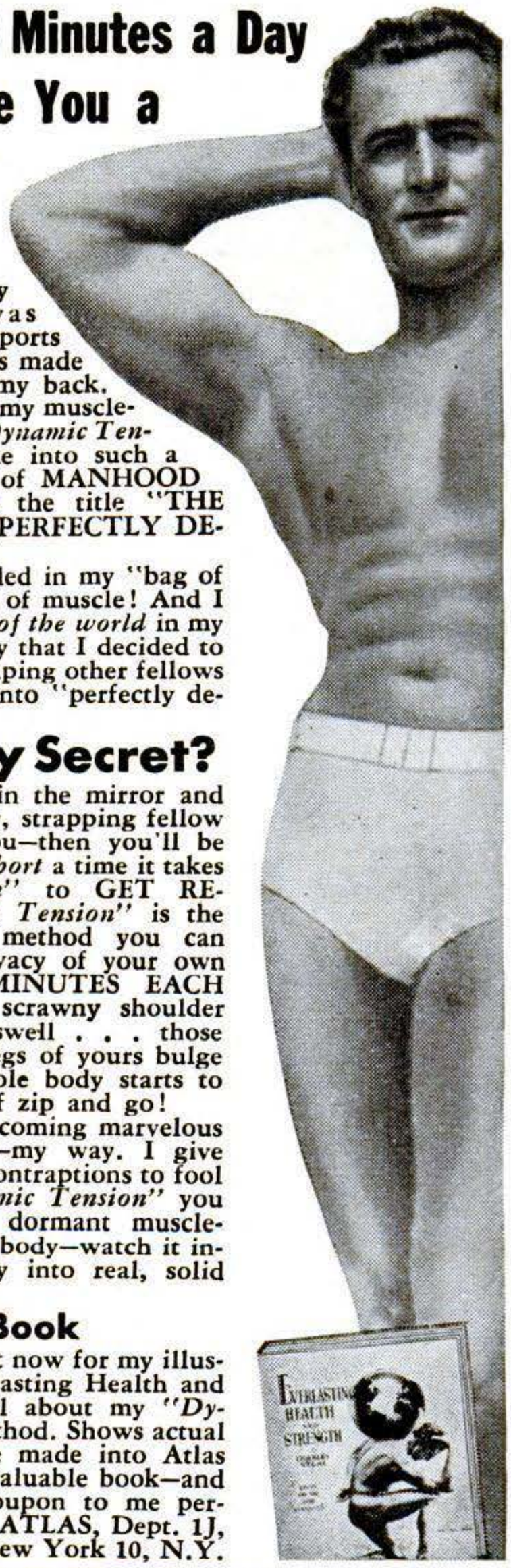

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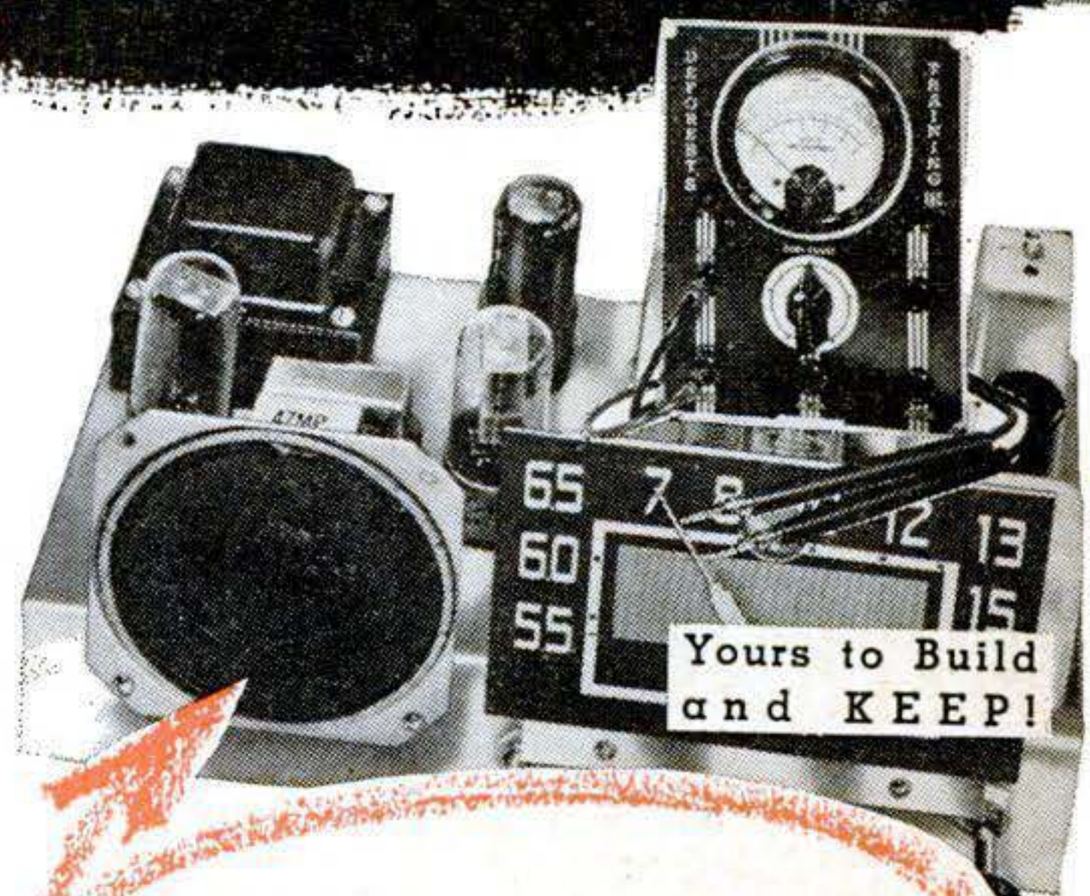

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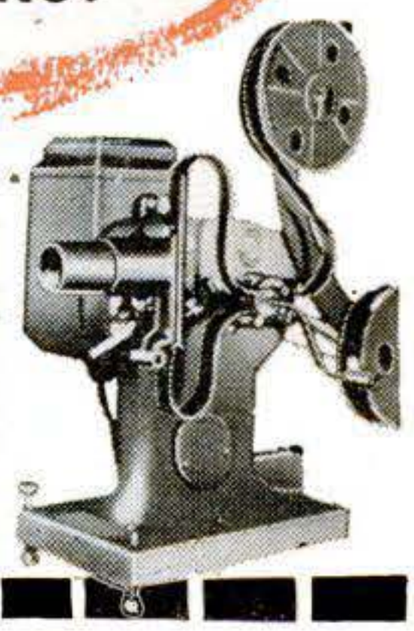

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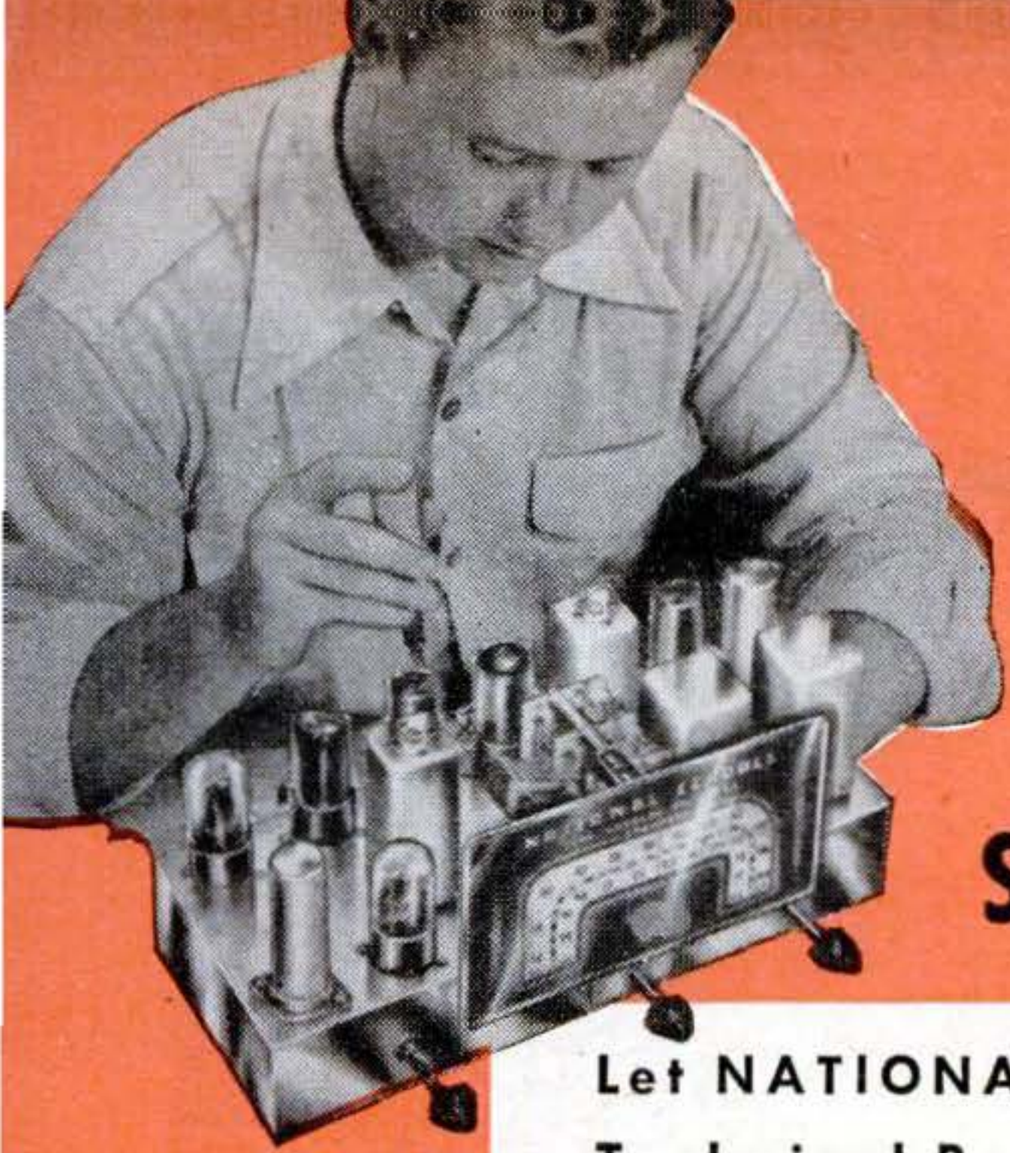

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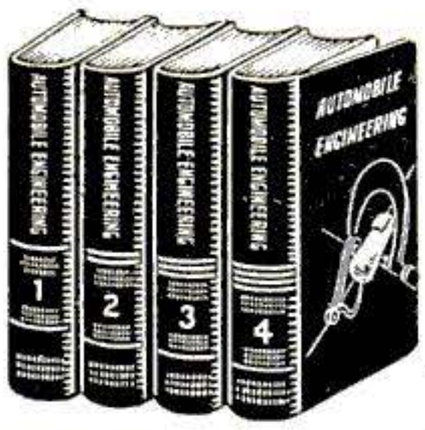

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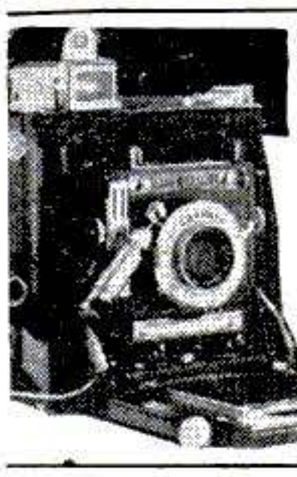

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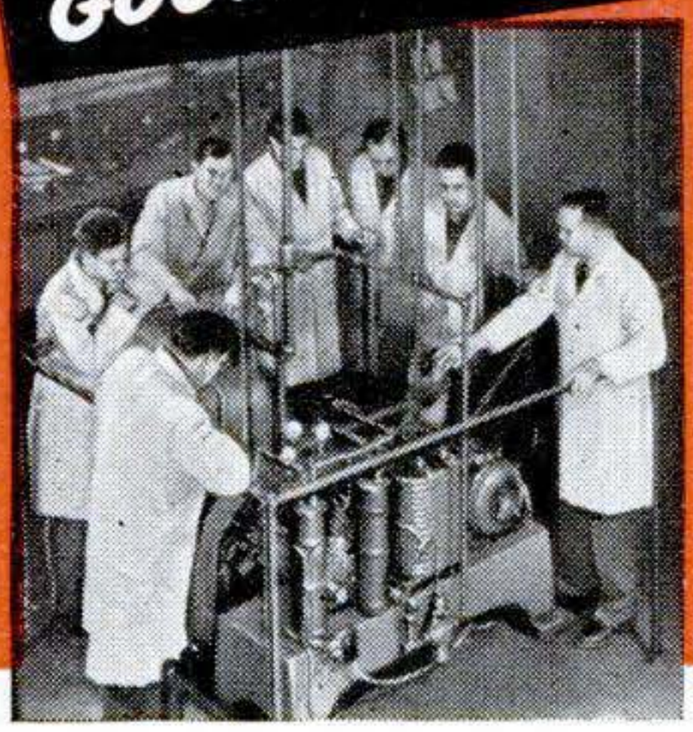

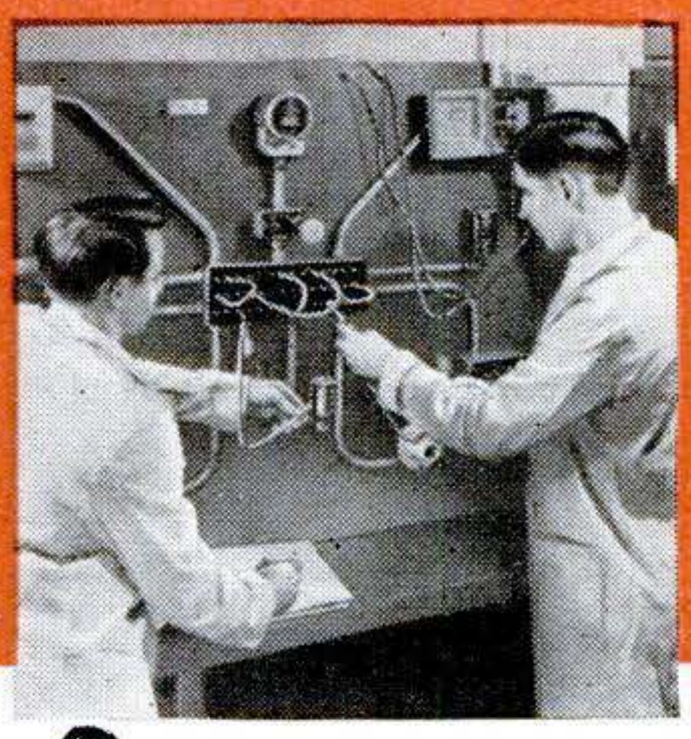

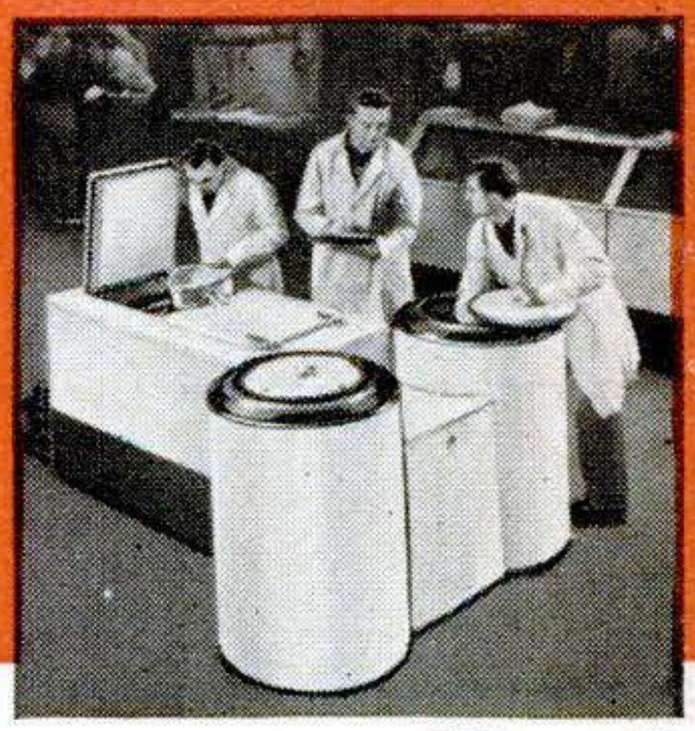

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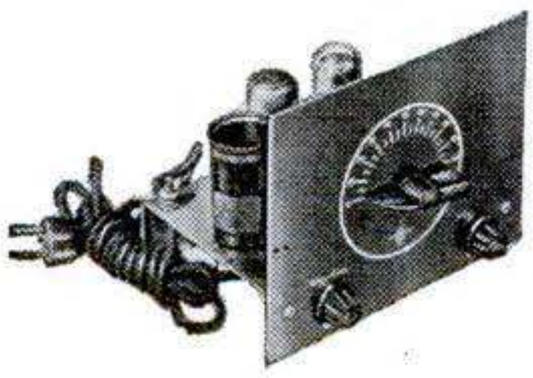

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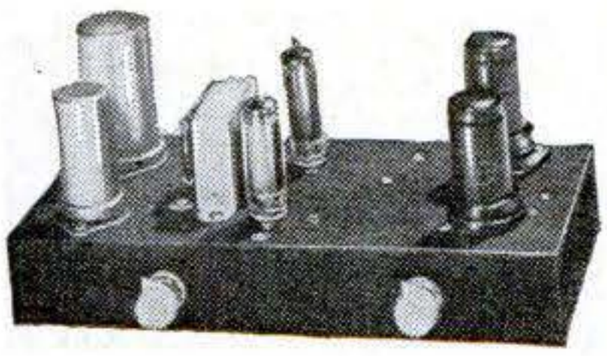

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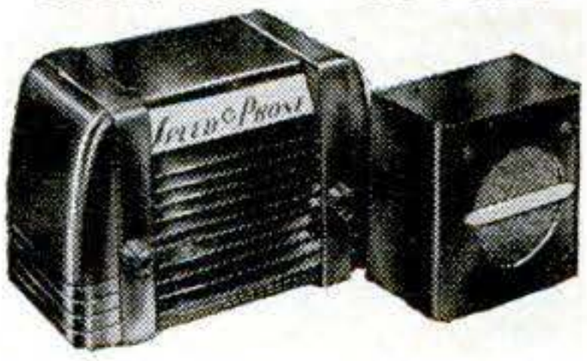

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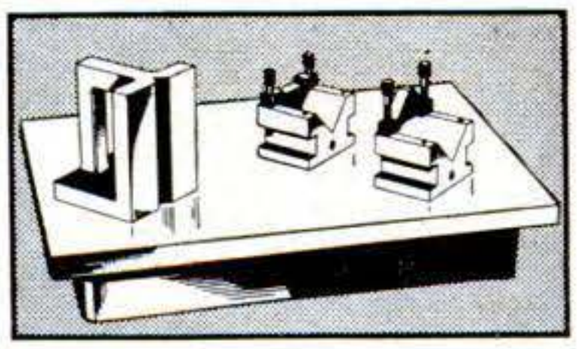

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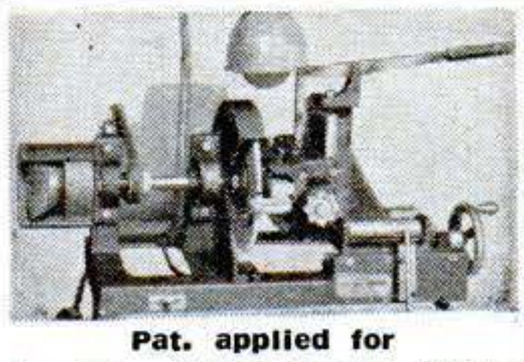

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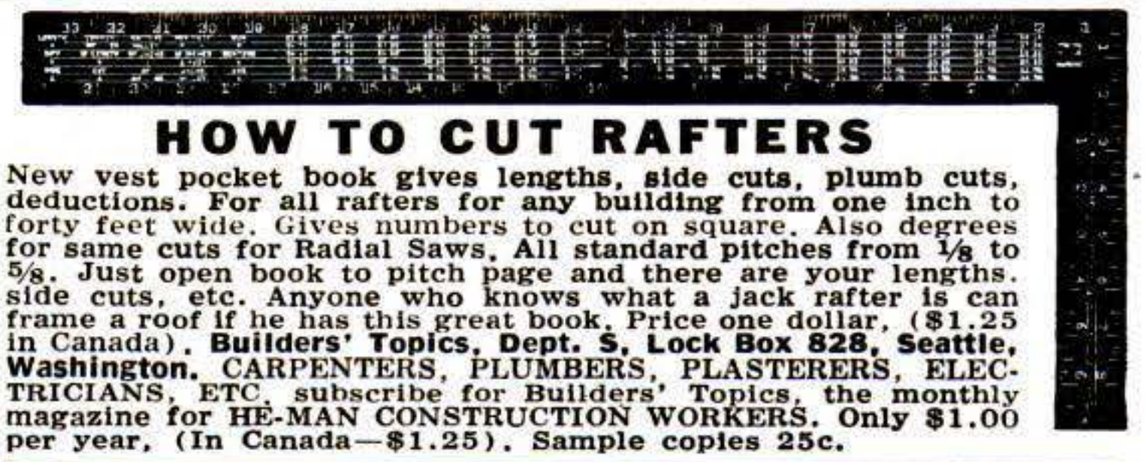

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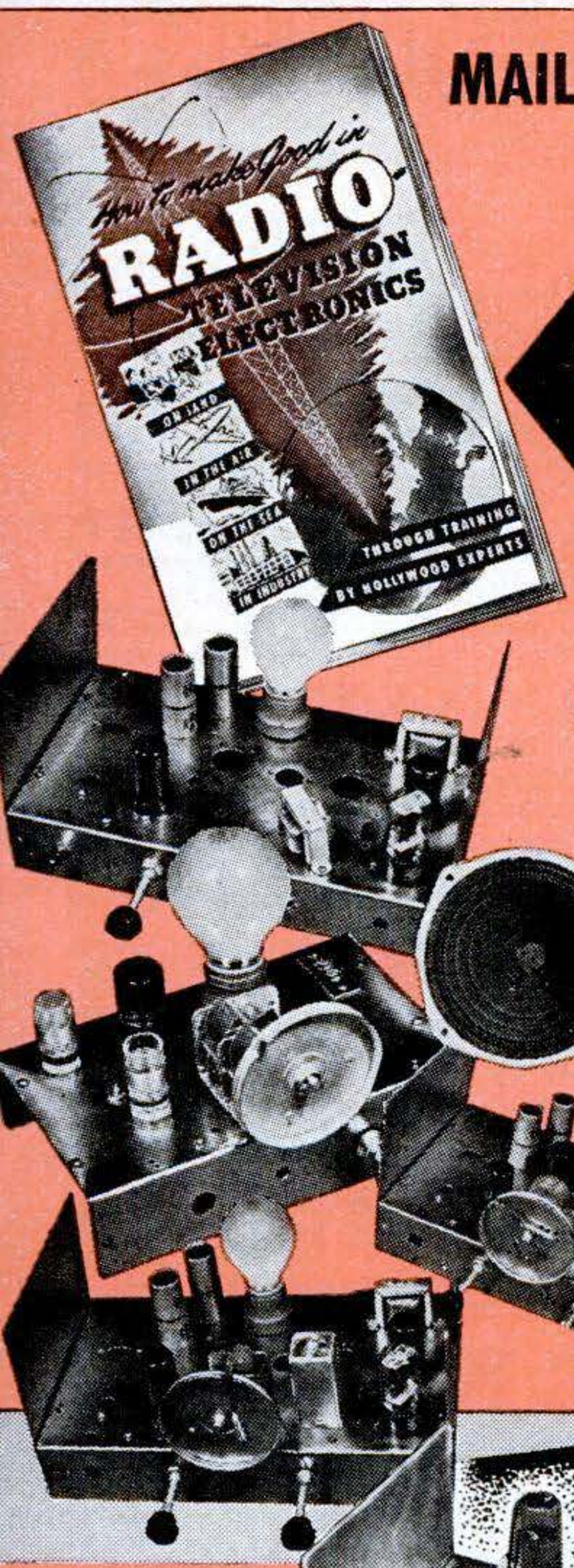

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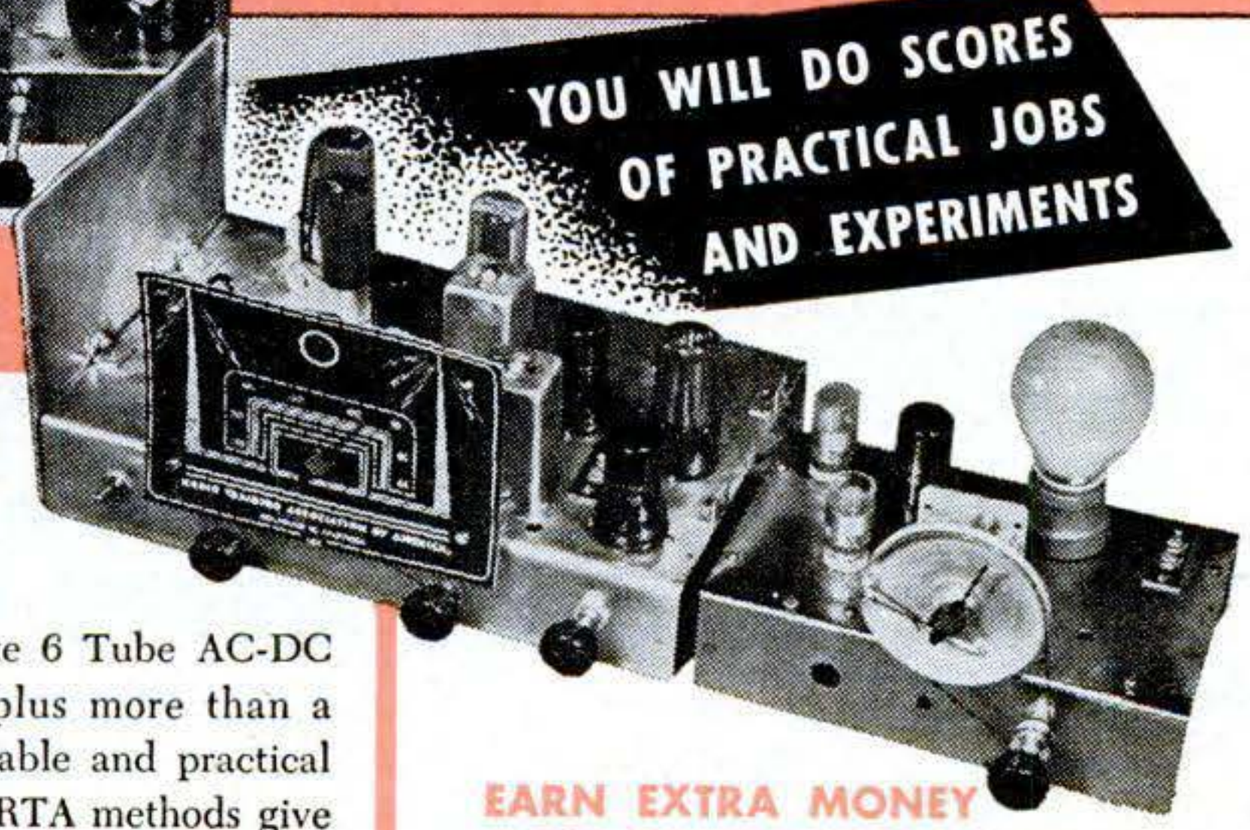

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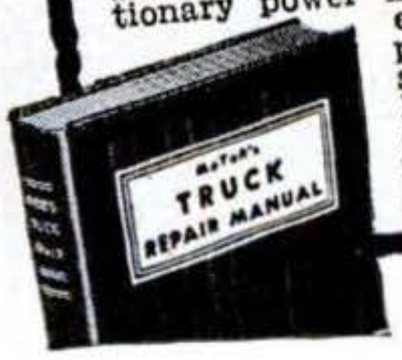

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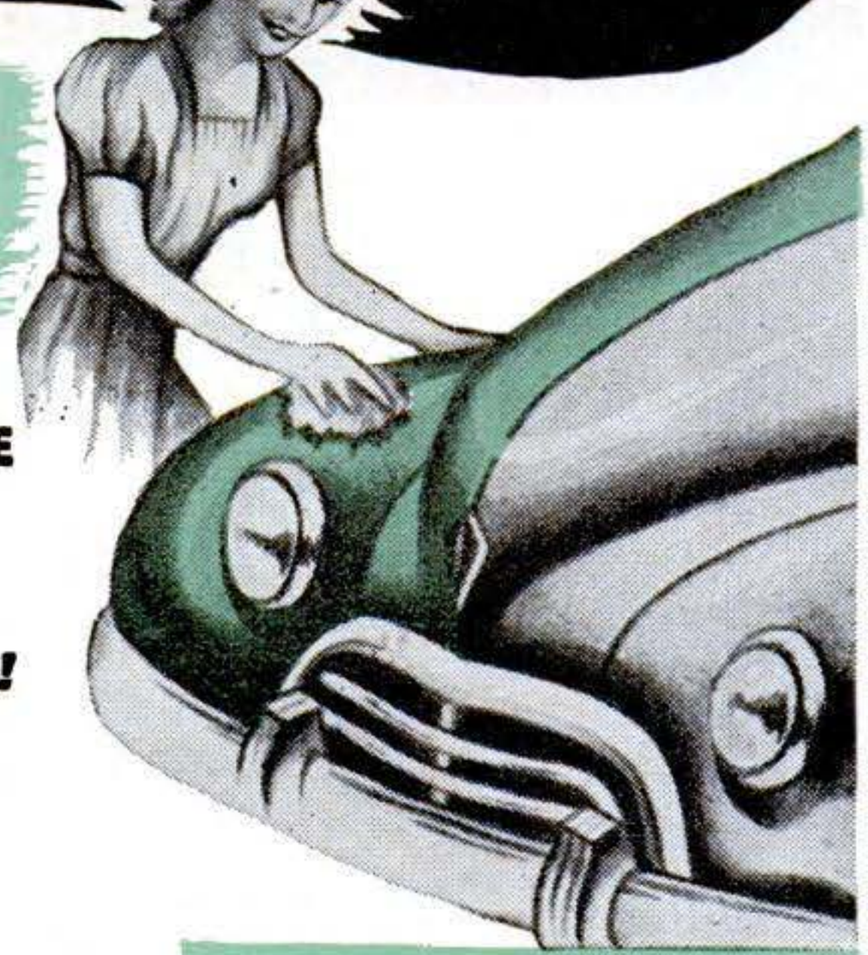

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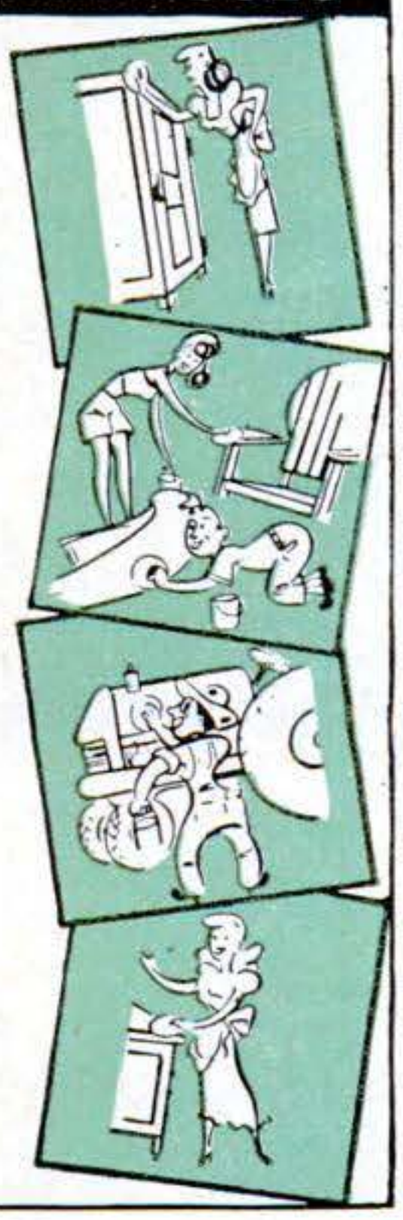

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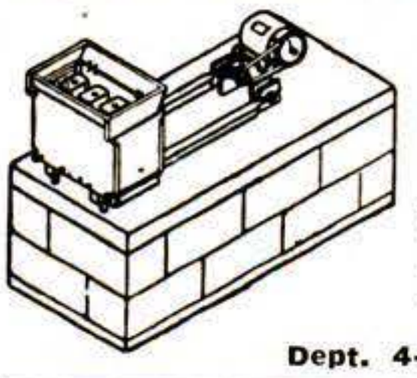

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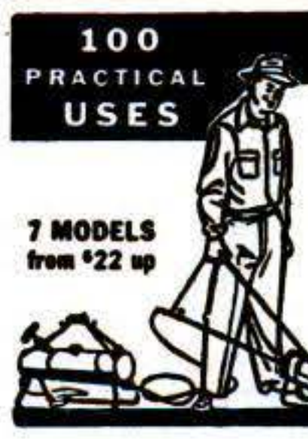

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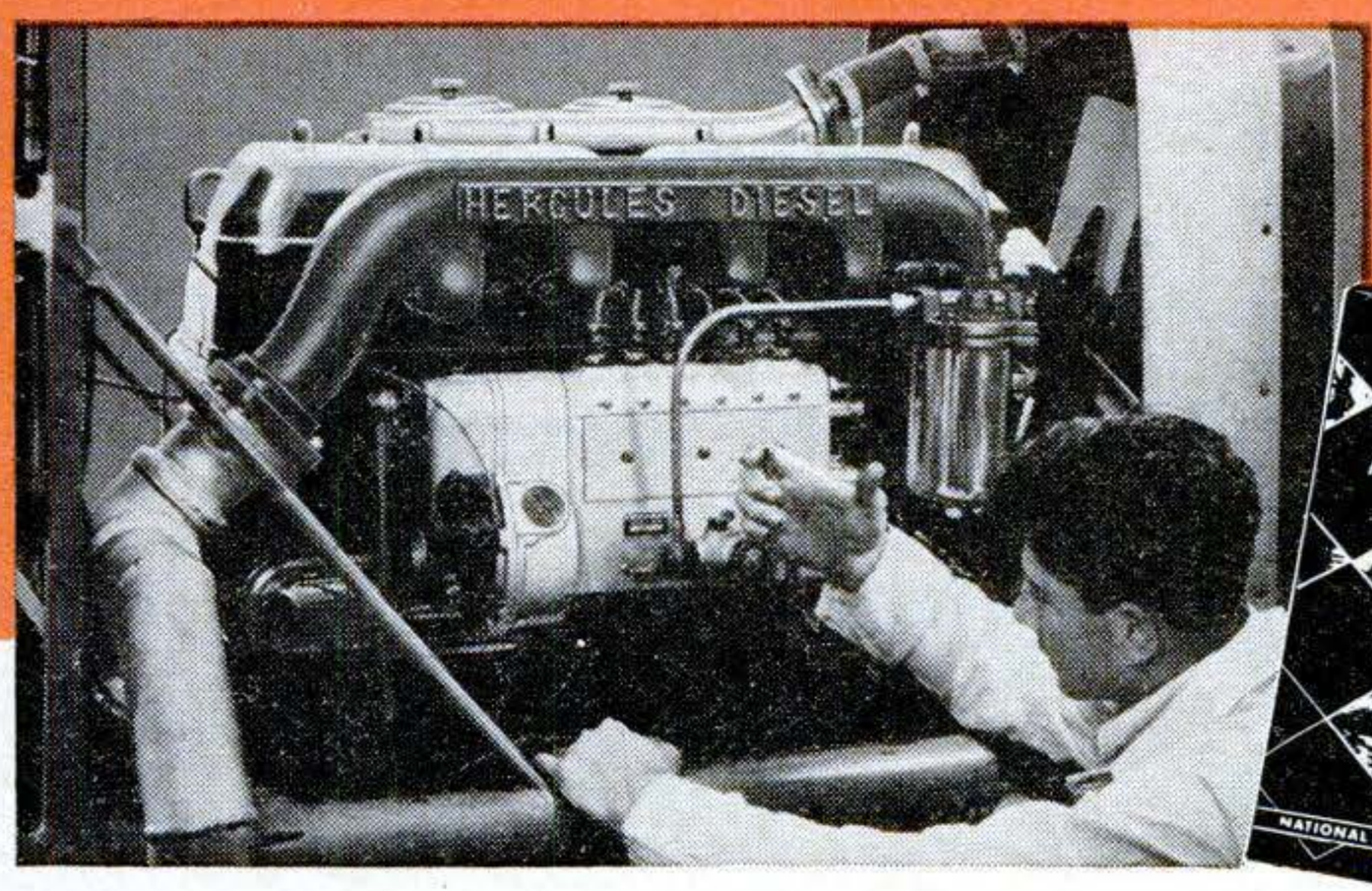

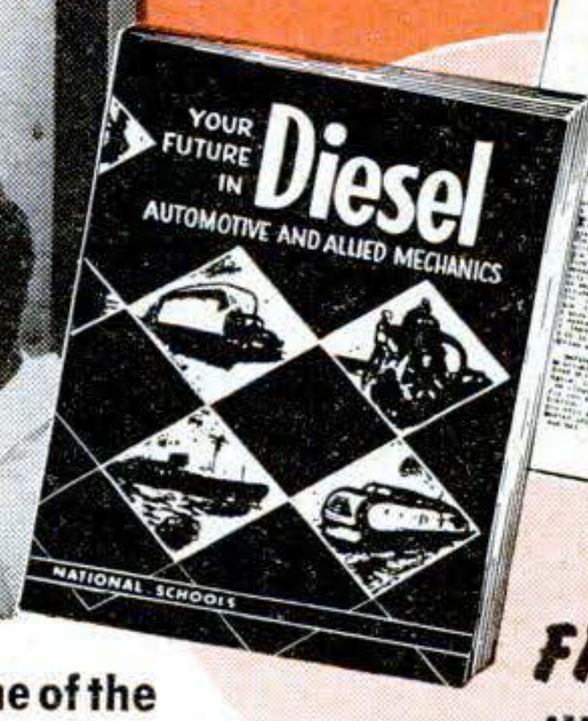

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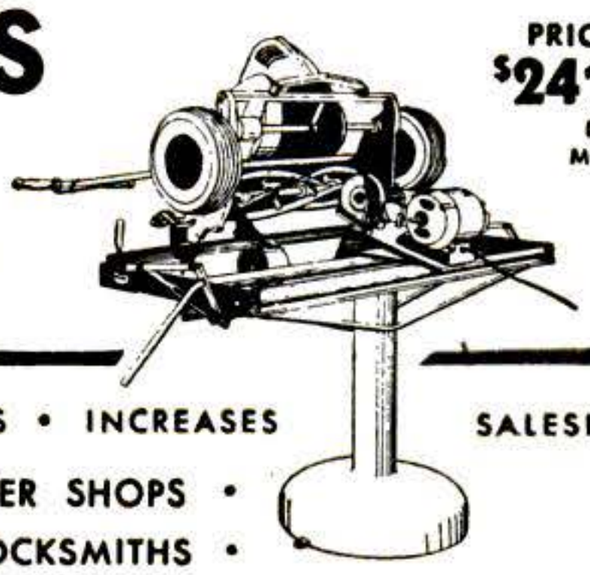

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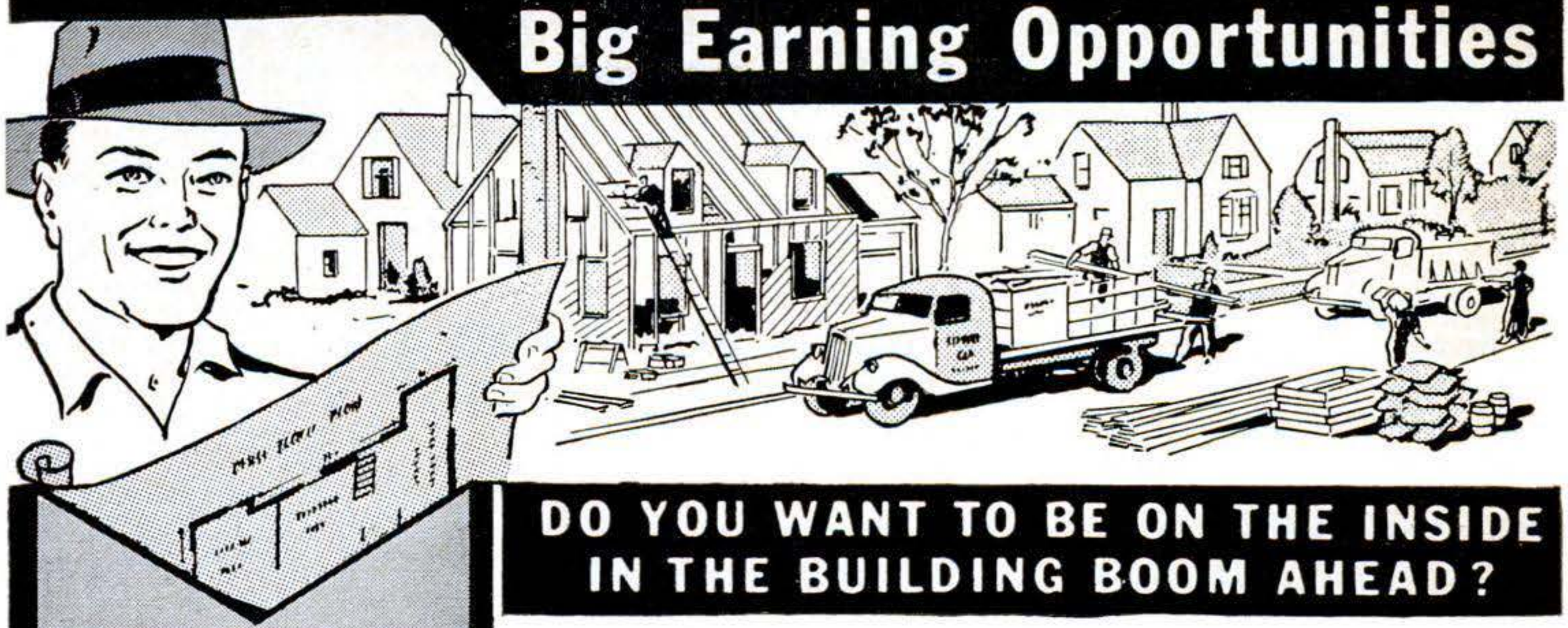

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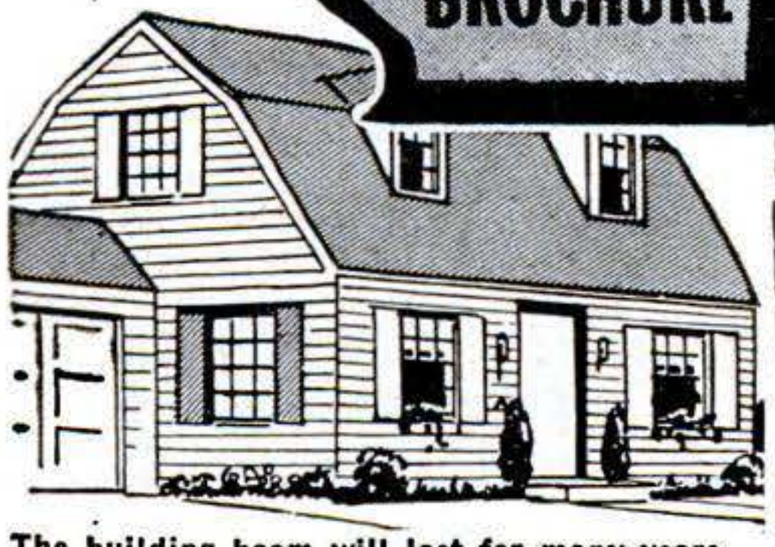

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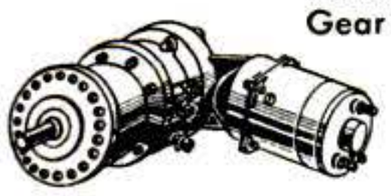

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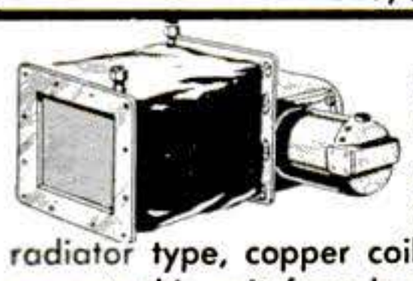

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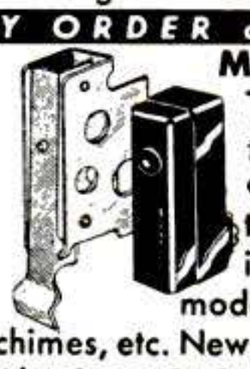

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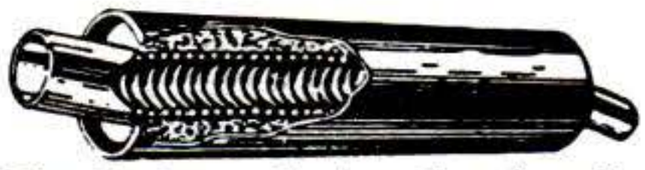

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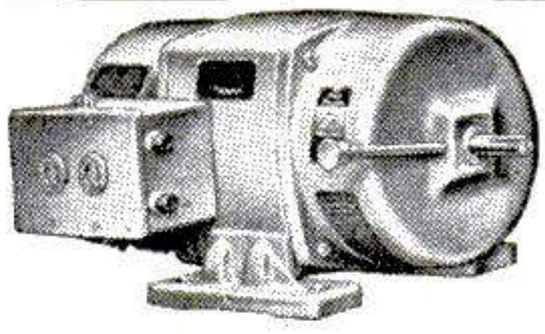

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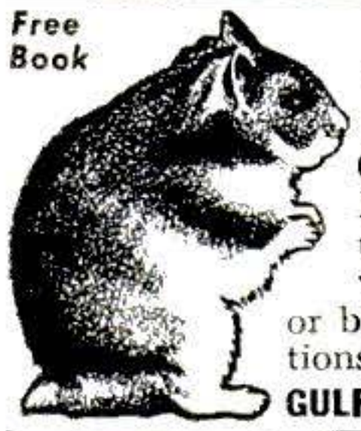

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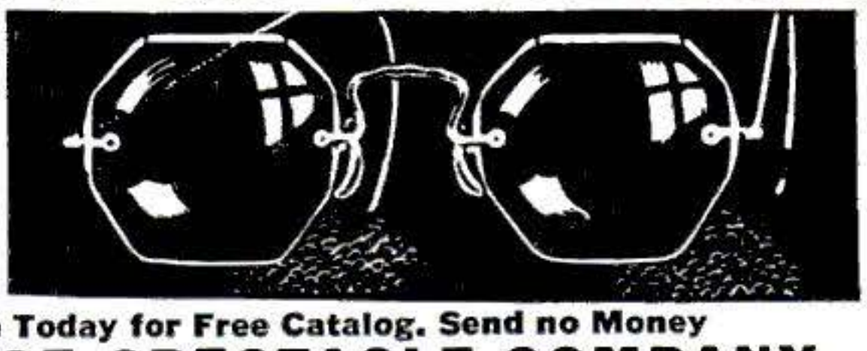

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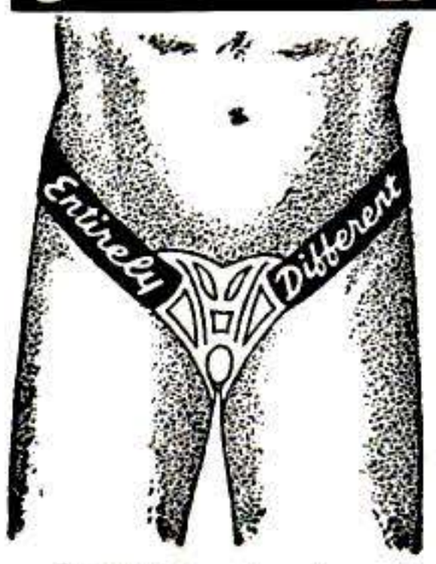

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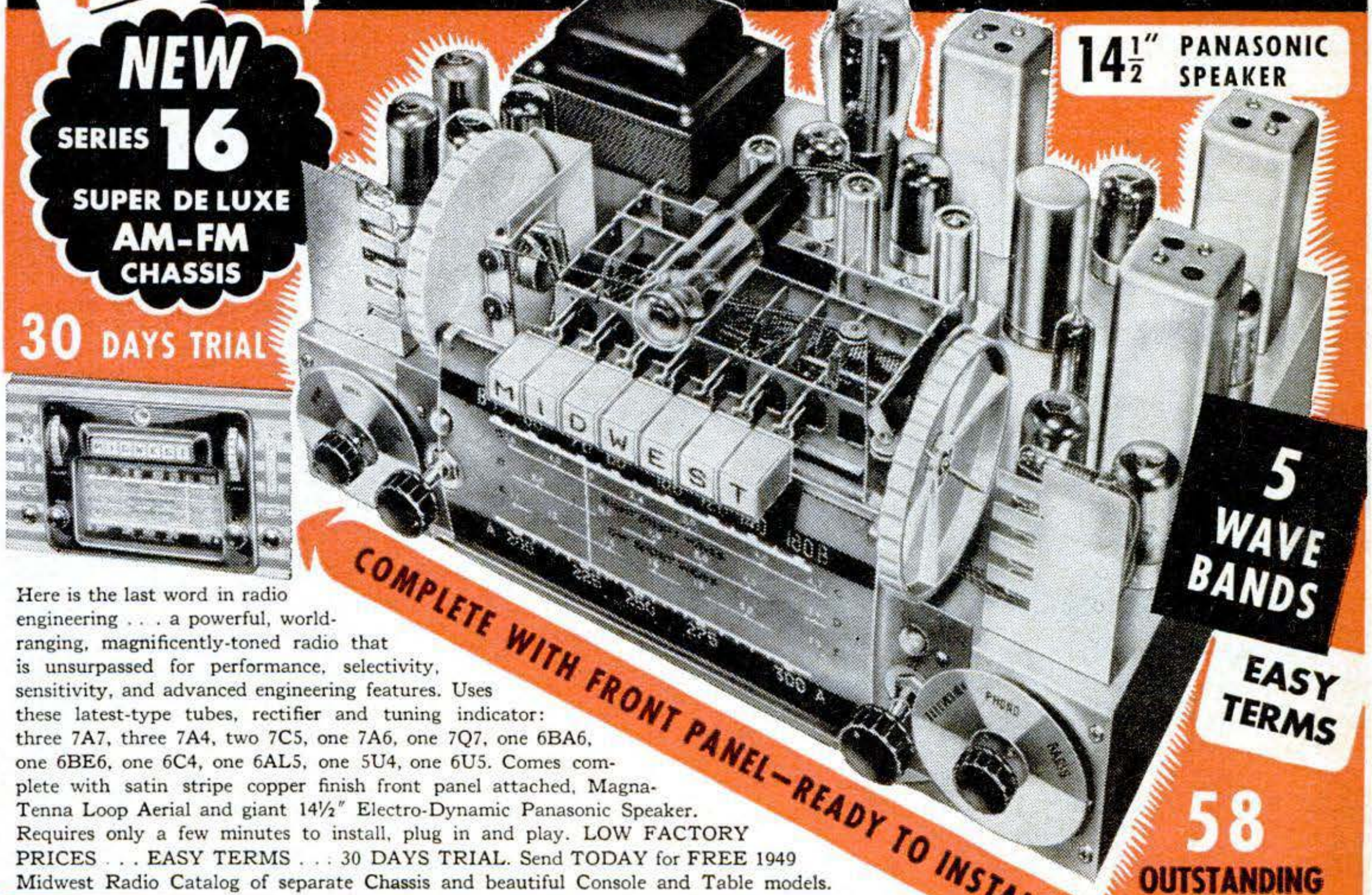

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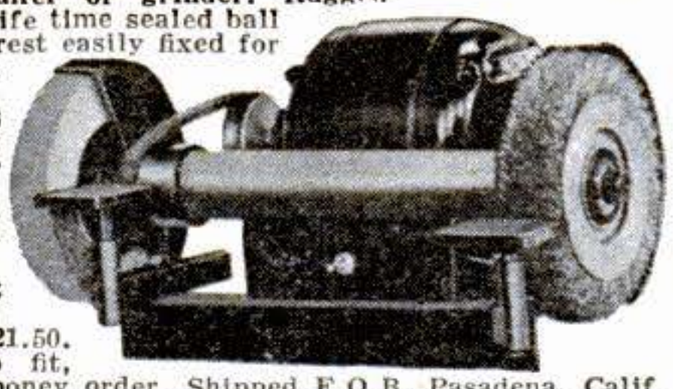

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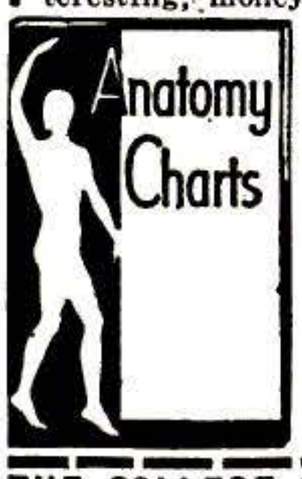

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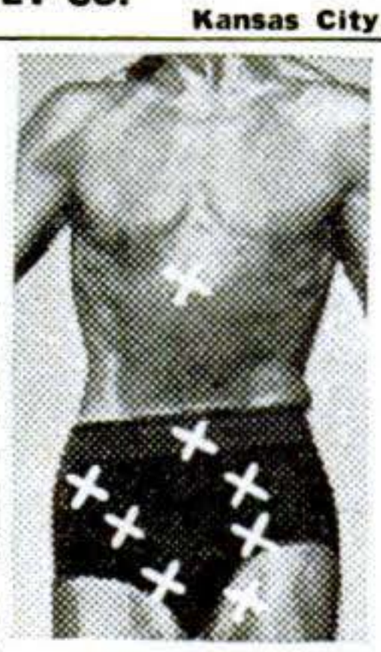

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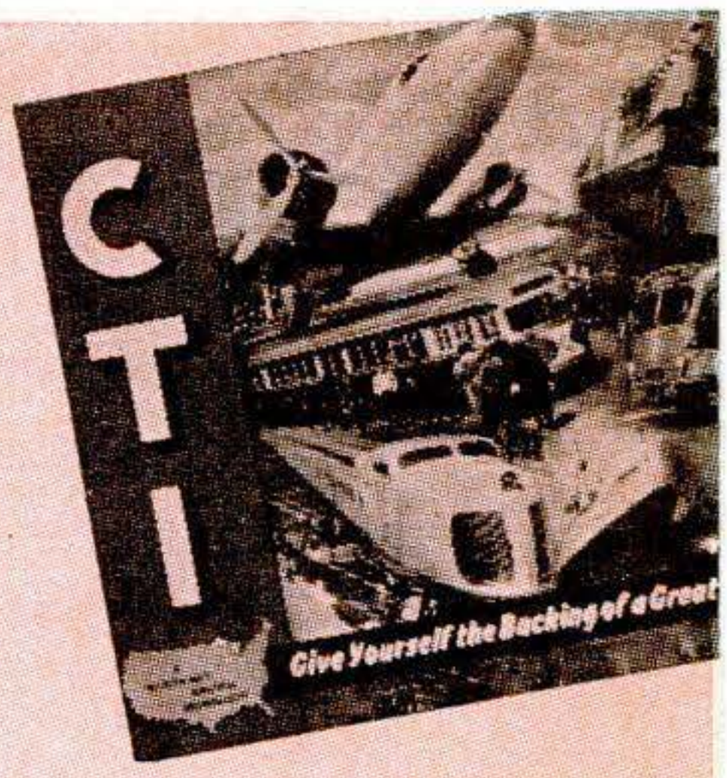

• You can easily put yourself in the place of F. D. Payne. He is just one more C.T.I. man who today looks to the future with confidence. He doesn't expect to become a millionaire as a result of his training, and he doesn't like to be high-pressured or kidded about his future any more than you do. But what he did want when he clipped the coupon and mailed it in for the C.T.I. booklet was a good job, a chance to show what he could do—and perhaps the opportunity to go into business for himself. Now, a C.T.I. graduate, he writes as follows: "I've installed over sixty-five tons of air conditioners, and no telling how many bottle boxes, meat displays, deep freezes . . . I'm on a month's vacation at the present and I plan to go into my own business . . . C.T.I. put me on the road and I think it will for others . . ."

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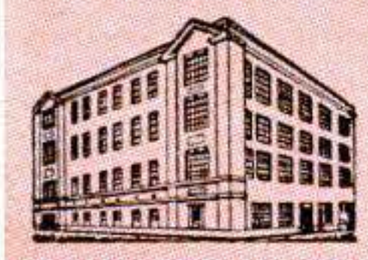

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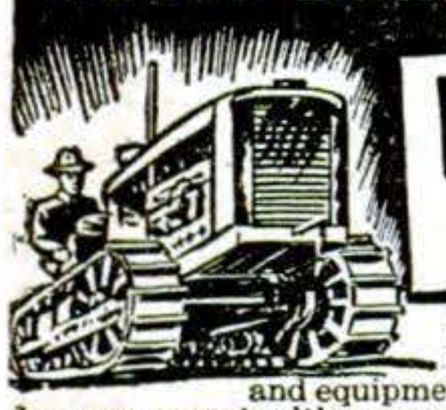

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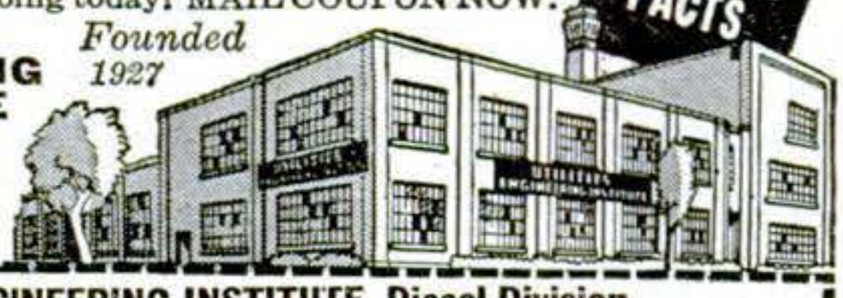

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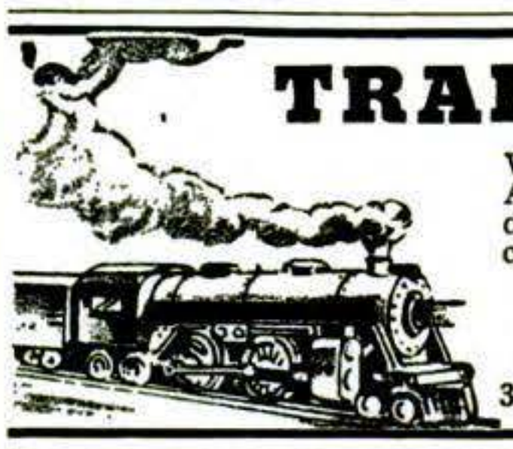

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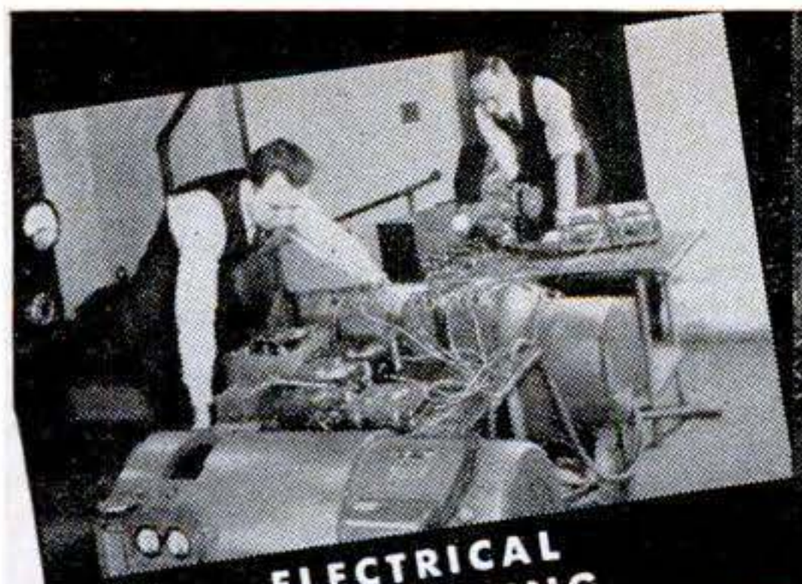

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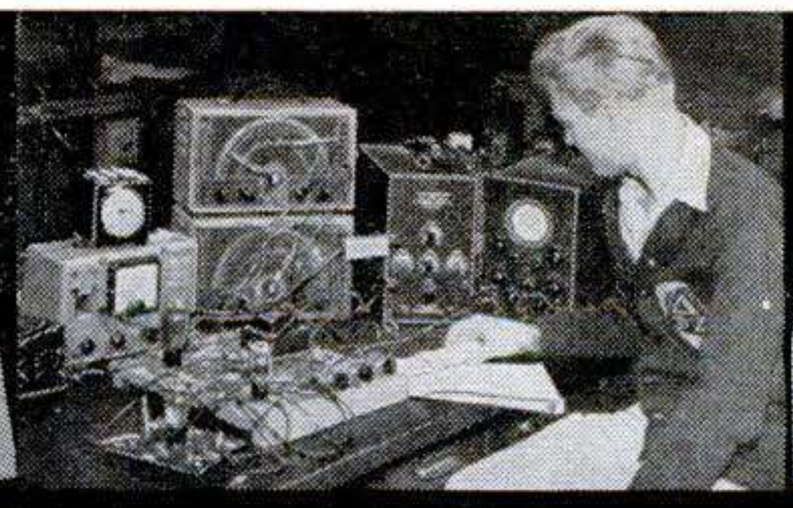

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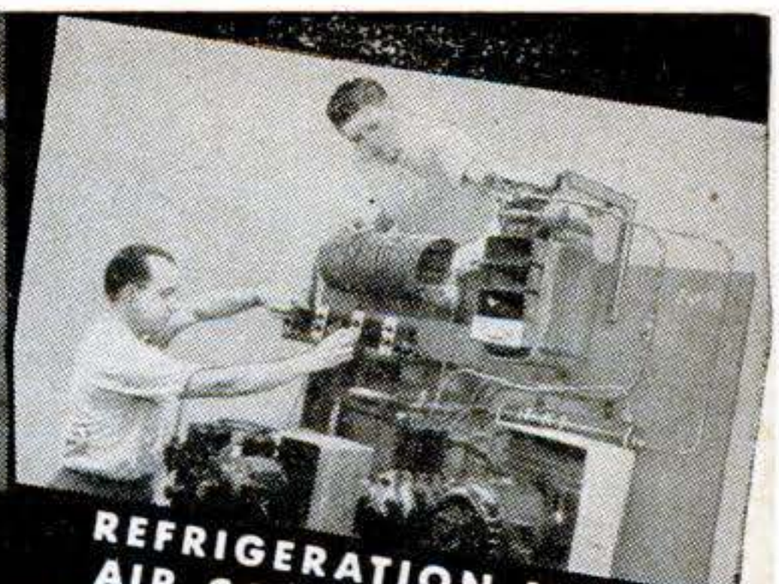

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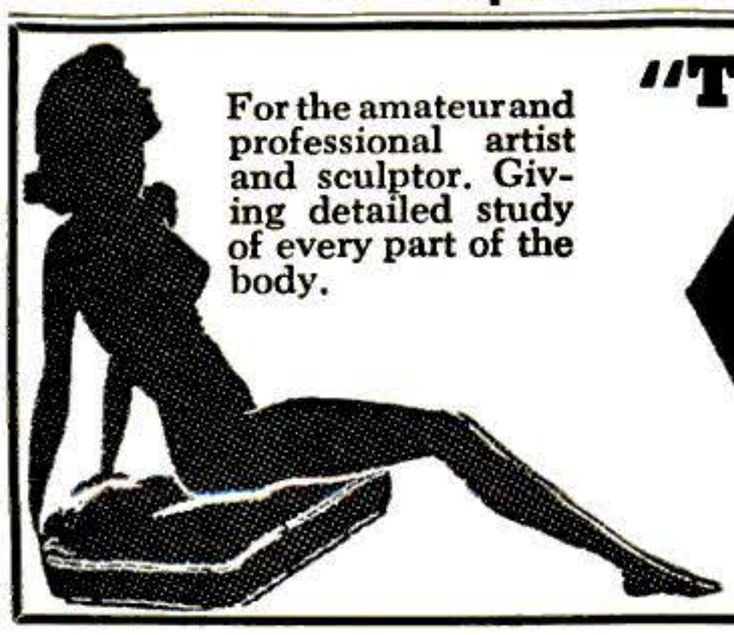

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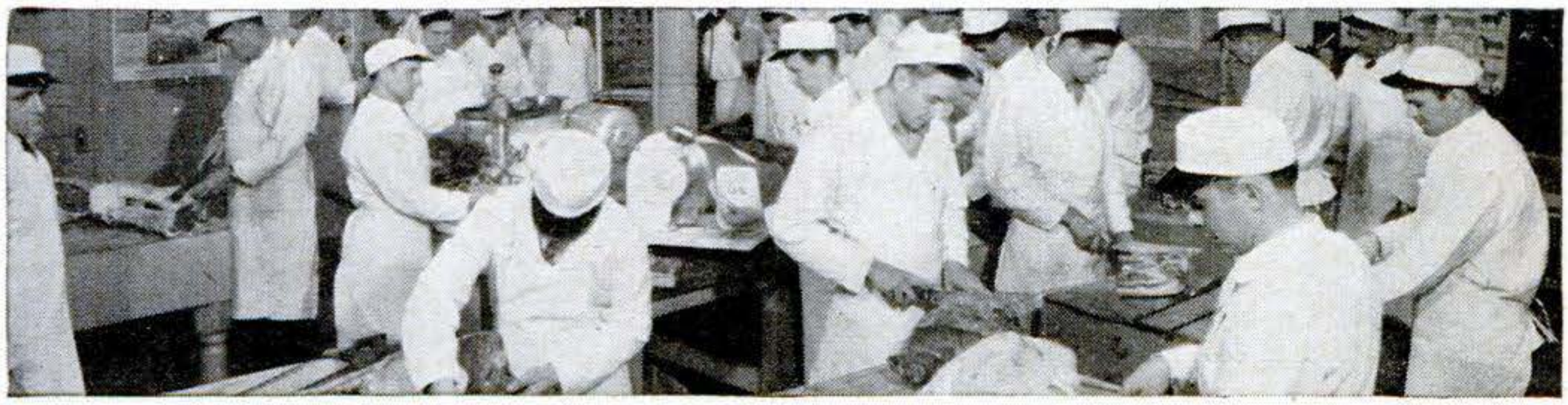

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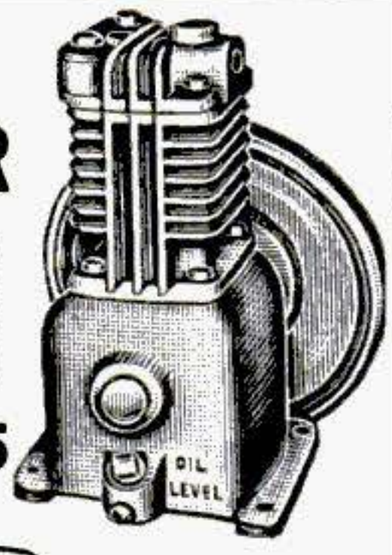

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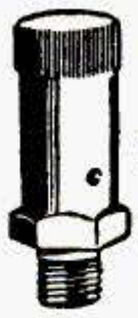

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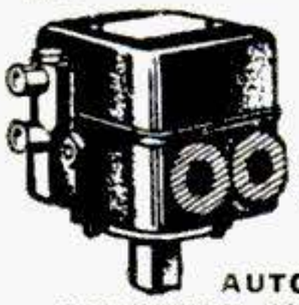

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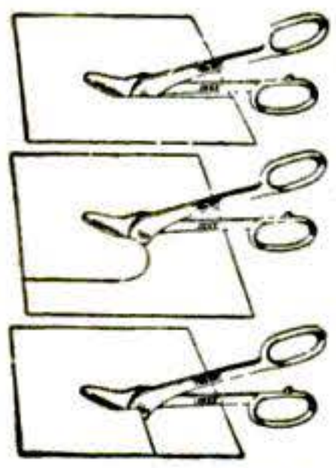

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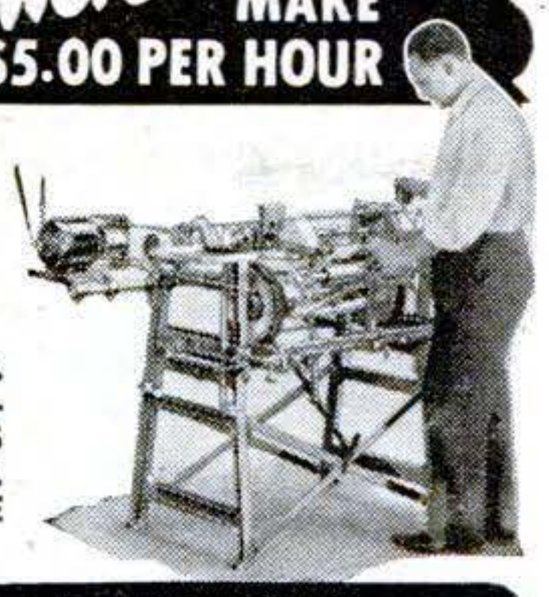

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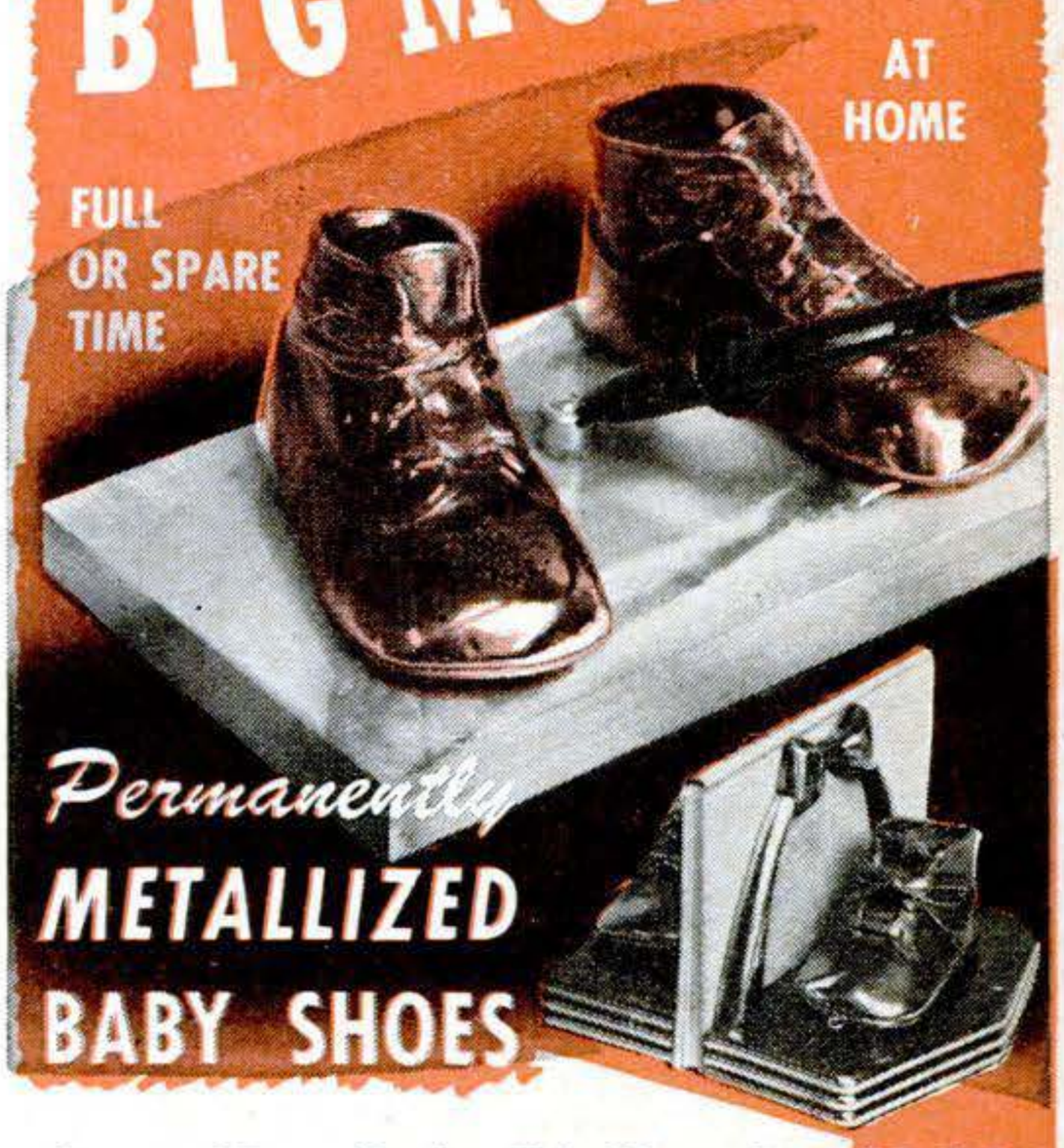

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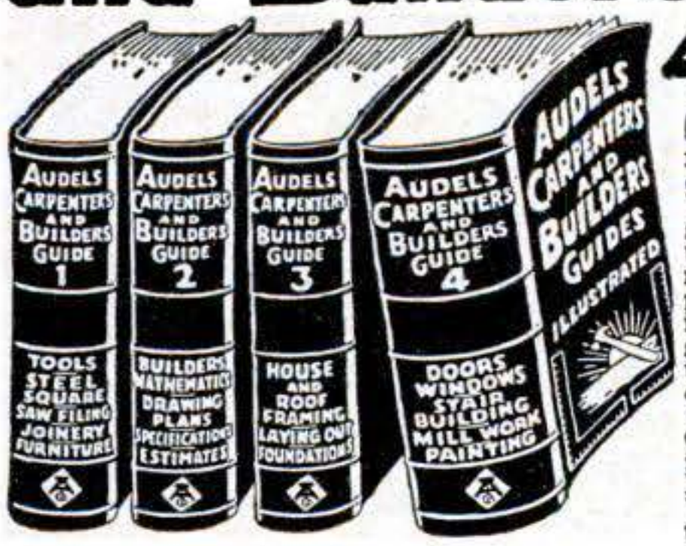

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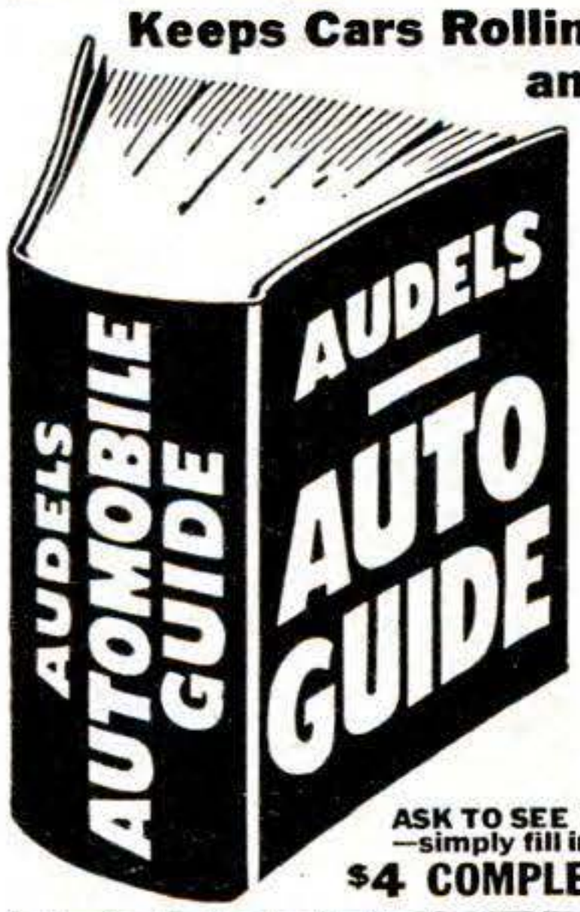

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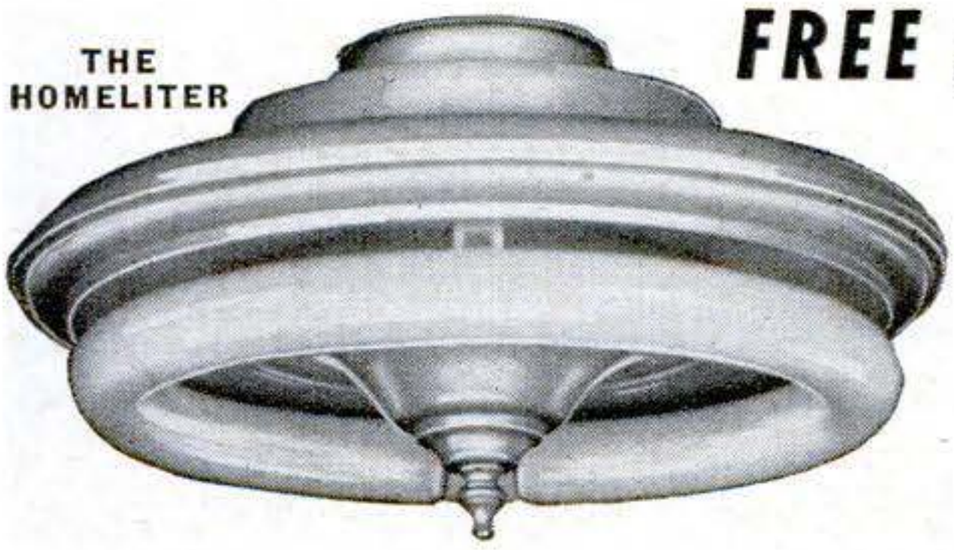

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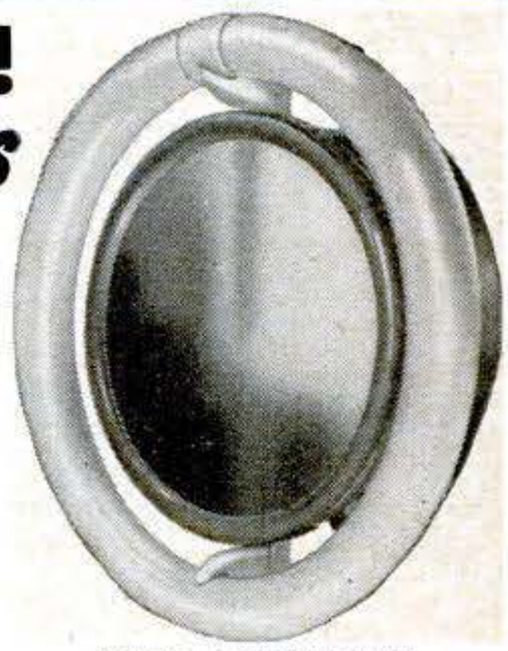

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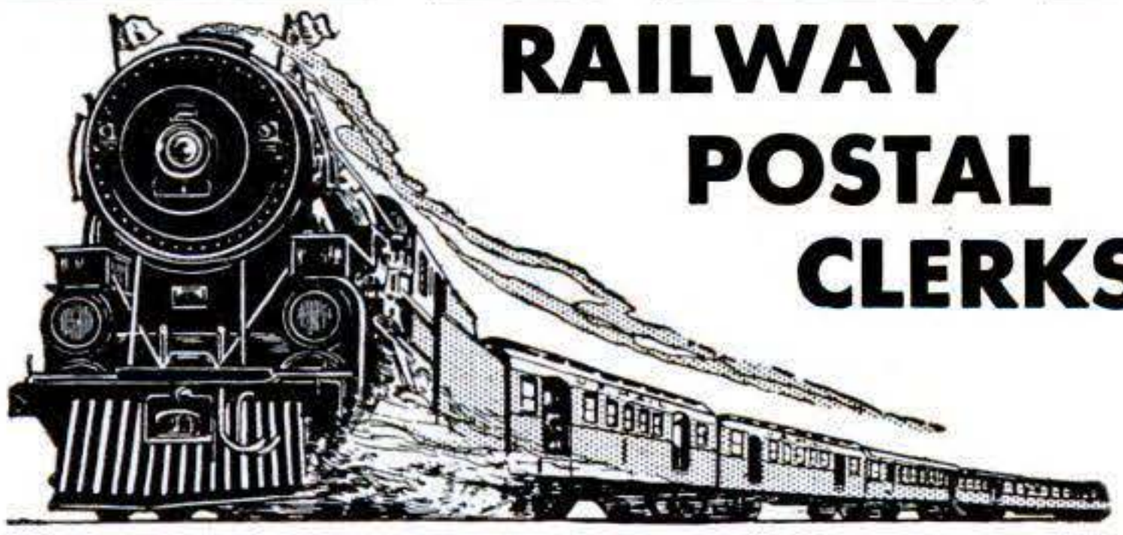

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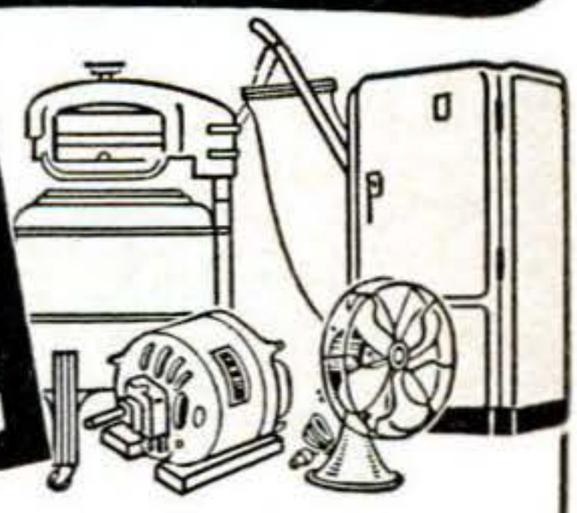

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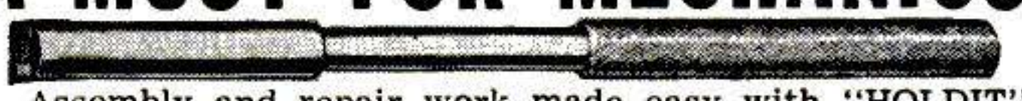

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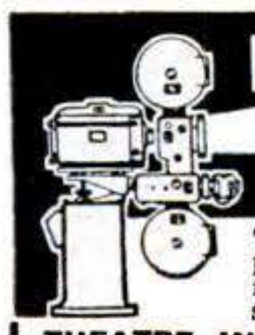

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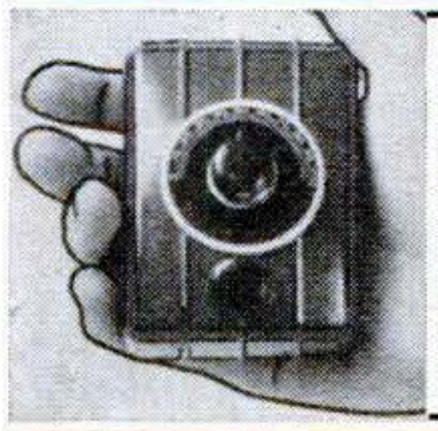

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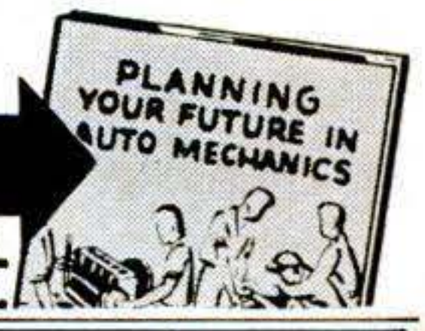

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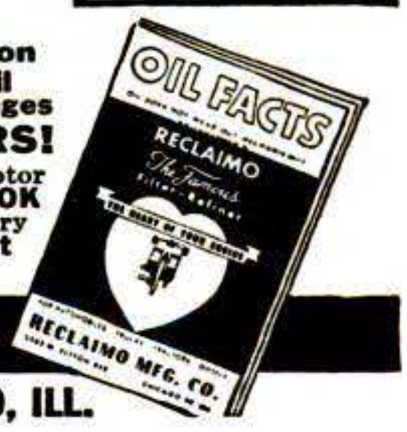

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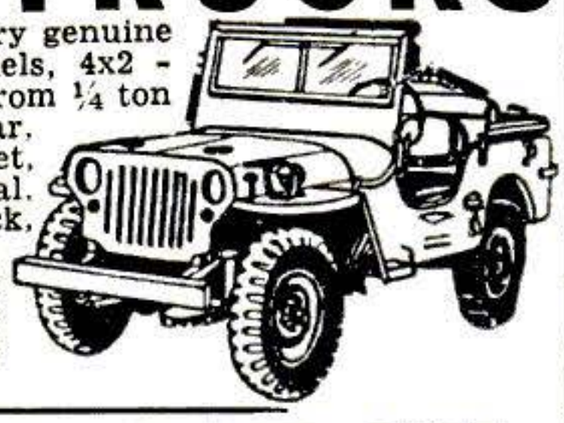

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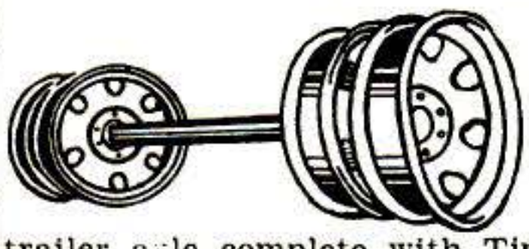

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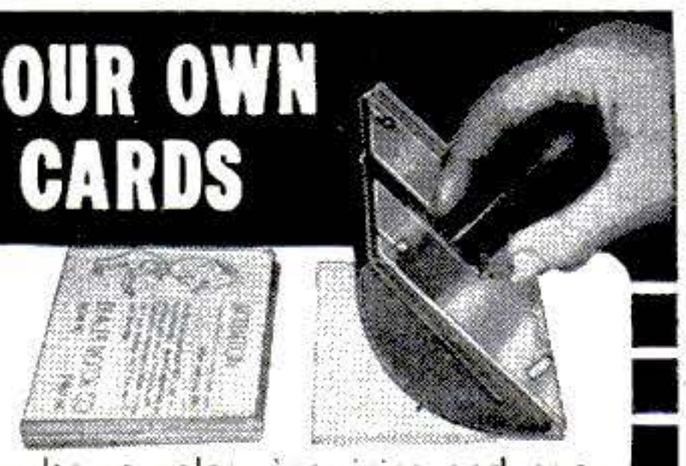

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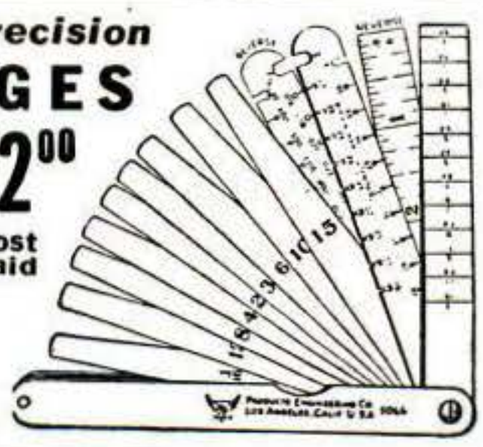

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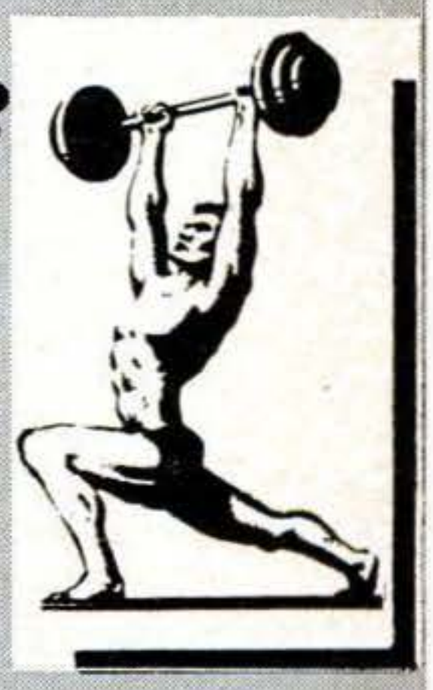

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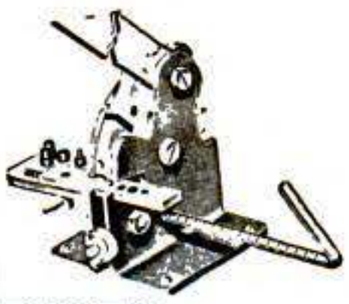

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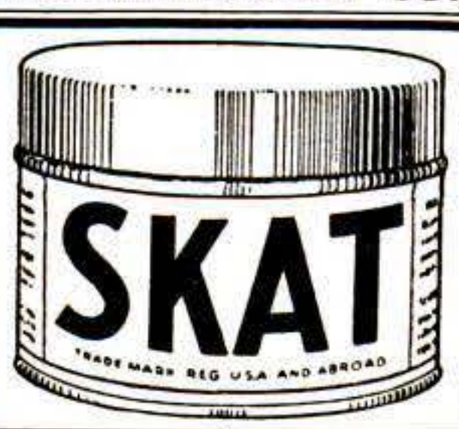

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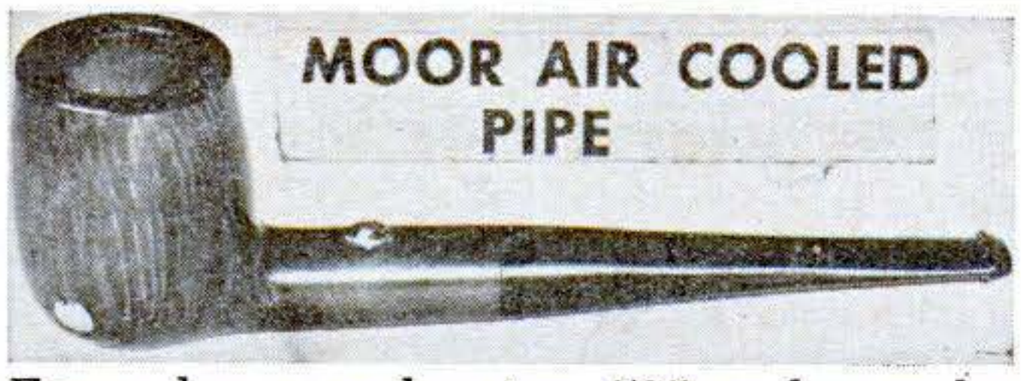

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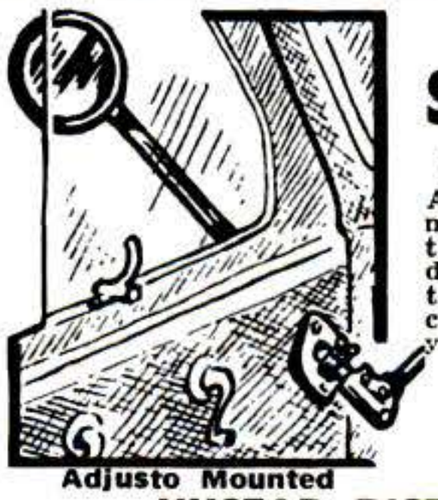

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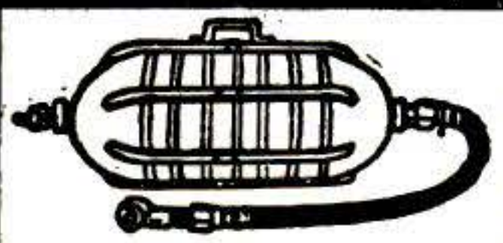

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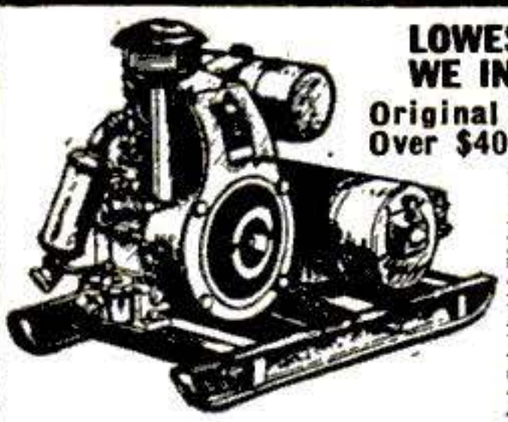

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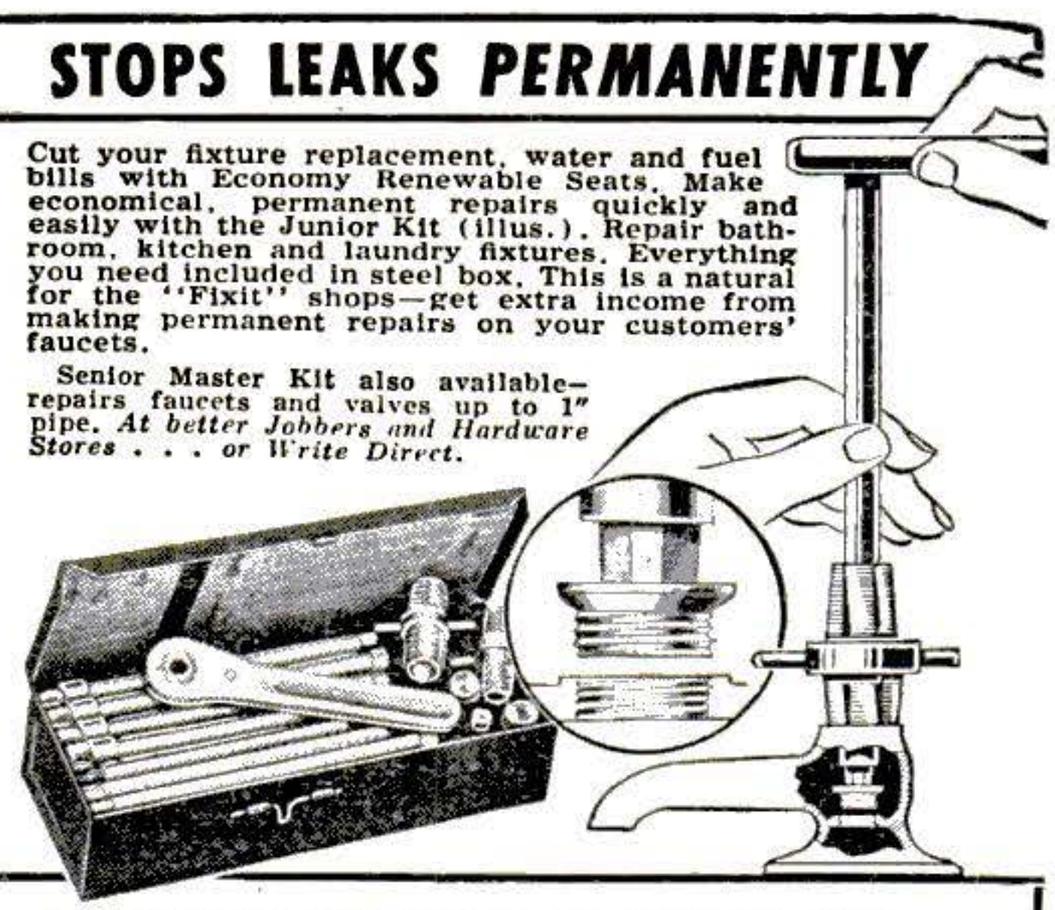

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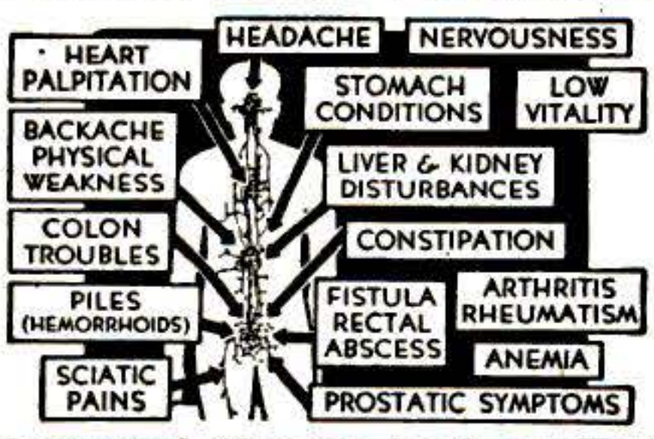

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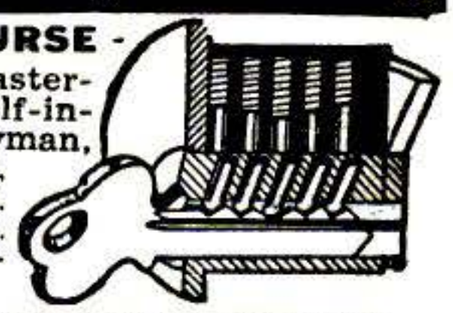

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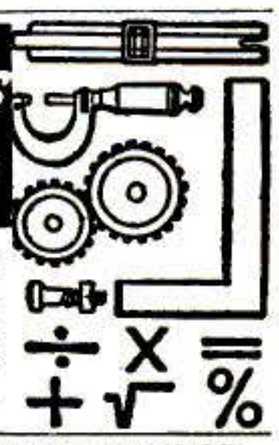

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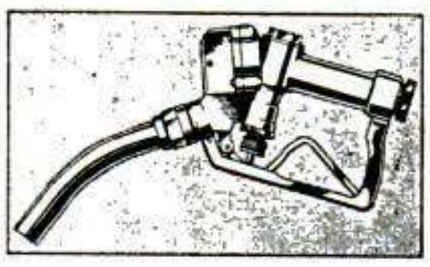

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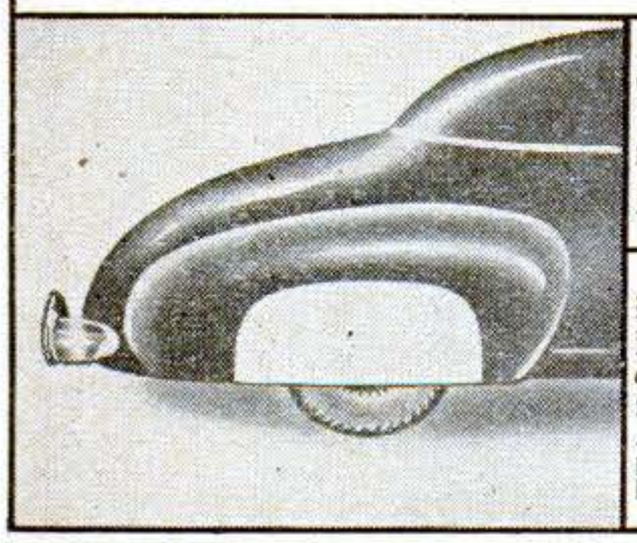

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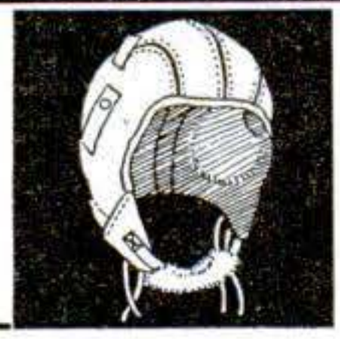

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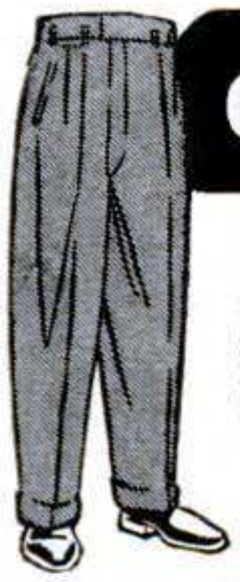

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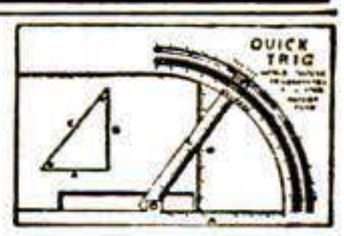

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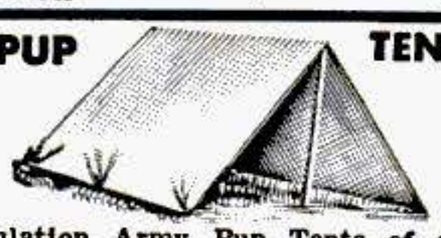

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, Boy Scouts, etc. Wgt. 8 lbs. **A100**—Tent only.... **$3.95**
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Ideal for driving, sun glare, sports and work. 24 carat gold plate frames with Pyralin sweat bar — adjustable nose bands. Large aviation type lenses. Case included. Shp. wgt. 1 lb. **No. 238**—Per Pair..... **$2.95**

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Five wheel type—counts to 99,999 and repeat. Nickel finish case. Has 1/8 inch round shank. Use it for any counting job. Brand new. Shp. wgt. 1 lb. **No. 241**, Each..... **98c**

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16x16 Ft.

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Works with any pail or bucket. Shoots a high pressure stream up to 30 feet. Use it for spraying garden and trees, for whitewashing, fire fighting, drainage, etc. Complete with 10 foot flexible hose. All brand new. Regular $3.80 value. **No. 244**— Each..... **$1.49**

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Fine forged steel. Ground but not polished. May be made into throwing or hunting knife or spear. Blade 6¾x⅞ inches, 11¾ inches overall. Will take and hold a fine edge. Shp. wgt. 1 lb. **No. 664-R**—Each..... **49c**

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Flexible 133 strand wire cable, 5/32 inch diam., 3300 lb. break test. Lengths up to 450 feet. Use as tow rope, guy wire, clothes line, etc. Weight per 100 feet, 4 lbs. Specify length wanted when ordering (minimum, 100 ft.). **Stock No. 421.** Per Foot..... **4c**

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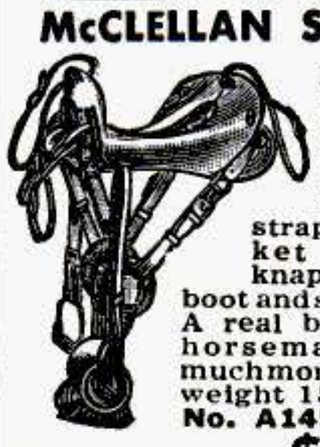

Brand new! Top grade cowhide. 12 inch seat. Hair girth. Has straps for blanket roll and knapsack. Gun boot and sabre loops. A real buy for any horseman. Worth much more. Shipping weight 15 lbs. **Stock No. A145.**
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Fits over your regular clothes and shoes. Can be cut apart for waist high waders, hip high or knee high boots, also arm length rubber gloves. Heavy gum rubber over fabric. Fine for those who work in the water, commercial fishermen, sewer diggers, etc. All brand new! Wgt. 14 lbs. **No. 183**—Each..... **$4.95**

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TYPE D2

A high pressure shatterproof tank of 500 cubic inch capacity—for 50 pound pressure or 6.9 cubic feet. All metal—measures 6½x24 inches. Threaded plug end vents. Shp. wgt. 6 lbs. **No. 388**— Each... **$2.45**

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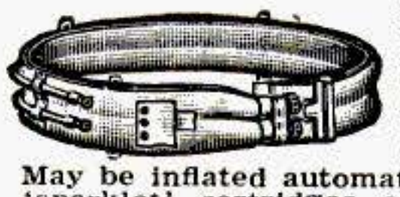

Right from the invasion beaches. Consists of two air chambers. May be inflated automatically with 'sparklet' cartridges or manually by attached hose. Adjustable in waist size. These belts are guaranteed brand new and air tight. You'll use them at the beach when swimming, for making life rafts—or in your boat as a life preserver. **No. 1261**—Each **$1.00**

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POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY 10

1 AUTOMOBILES

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MILLION Dollar Flight Airplanes. Fly Outdoor, Indoor. Sample 25c. Dozen $2.00. Alexander F. Kolinski, 759 South 25th, Milwaukee 4, Wis.

RESEARCH reveals nine outstanding money-making opportunities of today. Tested, proved successful. Very small capital, quick returns, no selling. Available nowhere else. Kays, 324 N. Centre, Cumberland, Md.

$3.41 PROFIT per hour interest you? Easy, amazing process velvetizes interiors, signs, novelties, radios, lamps, etc., at low cost. Free sample. V-Sparks, 1145 Queen Anne, Los Angeles 6.

HOME business. Spin angora wool. House of Angora, Springfield, Illinois.

57 MONEY MAKING OPPORTUNITIES

DETECTIVES Earn Big Money. Experience unnecessary. Particulars free. Wagoner, P-125, West 86th, N. Y., N. Y.

START your own business! Big money manufacturing novelties, plaques, statuary. Free catalog. Write Bing Products, 68-B9B Broad Street, Boston 10, Mass.

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"WHOLESALE" catalog. (Illustrated—10c) Bargains galore. Stafford, Box 5211-PS, Indianapolis 1, Indiana.

21 MONEYMAKING candy apple, popcorn formulas. Send $1.00 M. O. We can supply equipment for starting very profitable popcorn, candy floss business at little cost. Concession Supply, Dept. B, Sta. "B," Toledo, Ohio.

$12.00 PROFIT on 25c investment. Free folder. Suproco, Ogema 7, Wis.

INCREASE Your Earnings: Local Business Opportunities; Mail Order Information; Wholesale Supply Sources Valuable Money-Making Tips; Information. Free details. Rush name. Wilkin Company, Hillsboro 2, Ohio.

EARN $25 distributing 50 boxes of Greeting Cards. Over 20 different top quality assortments for Xmas, Birthday plus deluxe boxed stationery. Also make extra money taking magazine subscriptions. Details free! Cassell Co., 11-A Elm St., Westfield, New Jersey.

WIN contest money. General Contest Magazine gives hundreds of tips. Lists current contests and rules. Sample 25c. General Contests, 1609-A East 5th, Duluth, Minn.

METALLIZE baby shoes. Further information 3c stamp. Metal Crafts, Box 125-R5, Tampa 4, Florida.

SHINGLERS. Roofers earn big money lifetime. Start neighborhood business. Complete illustrated instructions. Money back guarantee. Cedar shingling $1.00. Asphalt shingling $1.00—both $1.75. Shingler, Box 88C, Penticton, Canada.

SCHOOL Seniors—Sell classmates America's most beautiful Graduation Name Cards. Largest Selection. 40% commission. Outsells all others. Free sample kit. Printcraft, Dept. P, 1425 E. Elm St., Scranton 5, Pa.

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

FREE Literature describing many money making plans. Jenkins, Atmore, Ala.

MONEY Making offers details free. J. G. Schroeder, Box 504-S Anaheim, Calif.

ANYONE can make $247.50 from war material costing $1.50! Actual manufacturers show you how. Amazing proofs free. Rolls Enterprises, 115A West Sixteenth, N. Y. 11.

"WESTERN Advertiser" offers many worthwhile moneymaking opportunities. Sample copy Free! Harold E. Edlund, 577 Kensington, Los Angeles 26, California.

CARS . . . Cash . . . Homes . . . Free to lucky contest winners! Win your share with our contest aids. $1.00 brings Prize Contests Bulletin. Winning answers, entry blanks . . . Literature free. Personal Contest Club, Station "P," Dept. 12-P, Brooklyn 12, New York.

EARN Up to $2,000 year, inventing simple items. Special cash markets. Hendrickson, Argyle 8, Wisconsin.

EARN Money Evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle 2, Wisconsin.

ENJOY life. Learn Waterproofing Business. Work anywhere. Others making thousands. Proof free. Bryan, Box 702, Cincinnati 1, Ohio.

SELL Watches, booklet free. Jewelbox, S-1455 Broadway, New York City.

WOULD You pay 3%—first $350 made? Color-illustrated book "505 Odd, Successful Enterprises" free. Expect something odd! Pacific, Oceanside, California.

PRIZE Contest Fans Reap Rich Rewards. Enclose 3c stamp. National Contest Bulletin, Box 2685-S, Miami 31, Fla.

A $100 a month hobby at home! No soliciting, no mail order, no meeting people. Easy, enjoyable pastime. Details, 25c (Refundable.) Laura Dickson, 1006-PS Elizabeth St., Anderson, S. C.

MERCHANT seamen earn big pay. Complete information how these jobs are secured $1.00. O. Coffee, Box 844, Sta. H, Los Angeles.

58 FORMULAS, PLANS, ETC.

OPPORTUNITIES! Catalog describing 200 Helpful Formula, Money-Making Books. Air-mailed throughout world for stamps. Adams-Brown, Boston 67, Mass.

FORMULAS—All kinds. Latest products. Literature free. Kemico, Park Ridge 15, Illinois.

10,000 FORMULAS and trade secrets. Free literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

CONCENTRATED vegetables. Highest grade, raw, dehydrated, in tablet and powder form. No drugs. Write today for free circular. Kiro Concentrated Foods, Tama, Iowa.

COMPLETE information, rocket design and fuels $1.00. Higgins, 727 N. Ivy, Arlington, Va.

LABORATORY tested formulas. Lists free. Pont, Box 635-PS, Terre Haute, Ind.

59 PLASTICS

PLASTIC—Sheets, Rods, Tubes, etc. Free List. Plastic Supply Co., 2618 St. Louis Avenue, St. Louis 6, Mo.

SEPTEMBER Special. Supply kit including powdered and liquid dyes. Luminous powder and cement. $1.75 Postpaid. Lucite, plexiglas, sheets, rod, tubes, findings. Free catalogue. Craft Plastics, Somerville 2, New Jersey.

LUCITE, Plexiglas. Any size sheets. Cost square foot (12" x 12") 1/16" $.96; 1/8" $1.25; 3/16" $1.52; 1/4" $1.80; 5/16" $2.23. Include 10% postage. Almac Plastics, 1150 Broadway, New York 1, N. Y.

INTERNAL Carved swans, bluebirds, goldfish, butterflies, etc., pins, $1.50. Rose or Daisy costume jewelry sets, $1.50 less findings. Also gifts and novelties. Crystal Floral Novelty Co., Somerville, New Jersey.

PLASTICS—dyes, finding, shells, craft supplies. Catalog, fabricating manual, 10c. Lucite sample, 35c. Gem-O'-Lite, Box 686G, North Hollywood, Calif.

CEMENTS, Dyes for all Plastics. Free Catalog. Handbook of Plastic Cementing and Dyeing $1.00. Crescent Engineering, 1130 Fairoaks, South Pasadena, Calif.

LUCITE Plexiglas. Any article you make polishes itself crystal clear by merely dipping in "Liquid Shine" for thirty seconds. Quart $2.95, gallon $8.75 postpaid. Send check or money order. Instructions free. Acwood Products Co., Box 263, Long Island City #1, N. Y.

60 CHEMICALS AND APPARATUS

LEARN Chemistry at home, from the House of Winn. Home of Supplies for student Chemists. New idea chemical and apparatus outfits for Home Experimenting. Photographic Scales. Semi-Professional Microscopes and accessories. Send 15c for retail catalogue. Established 1931. John H. Winn, 124B West 23rd Street, New York 11, N. Y.

INTERESTING Catalogue Rare Elements. Chemicals small quantities, processes. Dime refunded first order. Vicar Laboratories. Established 1916. Guerneville, California.

NEW Laboratory supply catalog of chemicals and apparatus. Contains many thousands of items with illustrations. Send 25c. Standard Science Supply Company, 1232 N. Paulina St., Chicago 22, Illinois.

HANDBOOK for Chemical Experimenters. Hundreds of Experiments; Illustrated. 50c. Experiment Booklet, 15c. Supply Catalog, 5c. Reading Scientific Co., Reading, Penna.

FREE catalog: Chemistry, mineralogy, biology, physics. Tracey Laboratories, Evanston, Illinois.

TERRIFIC bargains in chemical laboratory apparatus—Catalogue 10c. Ross, Section B, 68 West Broadway, New York, N. Y.

EDISON'S Home Laboratory made him famous. Start yours today. Catalogue Chemicals and Apparatus 15c. Microscopic Stain Catalogue 20c. Both for 25c. National Scientific Company, 2204 North Ave., Chicago 47, Ill.

EXPERT chemical information about your problem. Send with $1.50 to Osterberg Laboratories, 2101 Girard So., Minneapolis 5, Minnesota.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 10c. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

CHEMICALS, ounce quantities, apparatus, catalog 10c. Fleischer's Laboratories, Everett 49, Mass.

61 HELP WANTED

BOYS wanted. Over $50 week! Sell name plates for front doors. Write Dept. 8, National, 214 Summer, Boston, Mass.

EARN Up to $520 Month part or full time keeping books for small firms. Simplified System. Write Tax-Saver System, Dept. H, Fort Worth, Texas.

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

BOYS! Earn big money and bonuses easy selling brass name plates for neighbor's doors. Write Hubstamp, 357-B Congress, Boston, Mass.

ABRIDGED directory; 160 companies with foreign projects or interests: $1.00 cash (C.O.D. $1.27). Foreign Service Institute, Box 3980, Miami 24, Fla.

62 AGENTS WANTED

GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also, make money with our line of Automobile Initials and Sign Letters. Free Samples. "Ralco", XL-Roxbury, Boston 19, Mass.

AGENTS—300% profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

JOBS Open In Selling! Send name, address for Free copy Opportunity Magazine, listing hundreds of companies who need men now, full or spare time. Experience not essential. Opportunity, 28 E. Jackson, Dept. 15, Chicago 4, Ill.

BIG Money Quickly and Easily taking orders for complete line Personalized Initialed Buckles, Belts, Cap Badges, 2,000 Emblems. Fast repeats. Write today. Hook-Fast Company, Box 480-PS, Roanoke, Virginia.

MAKE more money selling personal initialed individualized belts, buckles, cap badges, tie holders, name plates, 2,000 emblems to choose. Big profits, whole or part time. Write today—special outfit order. Hookfast Specialties, Box 1425, Dept. 7, Providence, Rhode Island.

SELL new, used clothing from home, auto, store. Wholesale catalog Free. Calumet Sales, 4719 Kennedy Ave., East Chicago, Indiana.

CALL on friends with sensational Christmas Cards in handy assortments. Sell for $1.00. Profit up to 50c. Also popular-priced Personal Christmas Cards, Everyday assortments, Stationery, Imported Napkins. Samples on approval. Wallace Brown, Dept. J-4, New York 10, N. Y.

FREE sample! Big profit opportunity with amazing Glow-In-The-Dark House Numbers, switch plates, pictures, decals, religious articles. Represent large manufacturer. Madison Mills, 303 Fourth Avenue, New York 10, N. Y.

PLASTIC Christmas cards. Exclusive new plastic, sachet, panoramic, and carols Christmas assortments. Five leading 21 card $1.00 feature assortments. Six portfolios of personal cards. All this plus America's fastest imprint service. Free samples. Elmcraft Card Co., 5930 South Western, Chicago 36, Ill.

$25 YOURS for selling only fifty $1.00 boxes, new exclusive different Christmas and all-occasion cards; also extra cash bonuses. Send for Champion Cheerio 21-card box on approval. Free samples 6 new personal groups and stationery. Write today. Dept. 37, Pen-Brush, 154 Nassau St., New York 7.

AGENTS Wanted for our Slot Machines and coin operated amusement games in every town and community. Sell to clubs and homes, or start a route. Webb Distributing Co., Dept. P40, 6 So. Kedzie Ave., Chicago 12, Ill.

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A DRESS yours with every 3 you order for yourself and family. Amazing new bonus plan. Everything Free. Harford Frocks. Dept. S-9129, Cincinnati, Ohio.

AMAZING Profits $25.00 for selling 50 $1.00 DeLuxe Xmas boxes—embossed 50 and 25 for $1.00 name imprinted. Free samples. Ed-Brite, Dept. 8-A, 435 North Terrace Avenue, Mt. Vernon, New York.

NEW exclusive Xmas photo greeting cards, amazing value, big profits, approval samples. Spooner Greetings, 115 Chauncy, Boston, Mass.

SALESMEN, Build year round business for new fast selling Household item. Big profits. Easy Sales. Plenty repeat business. Write at once for full Particulars. Lytle Supply Co., Ave. 6, Fredericksburg, Ohio.

MEN'S shirts, pajamas. Steady earnings, cotton dresses, nylon slips. Free sales portfolio. Jarod Manufacturing Corporation, Rockville Centre 5, New York.

CHRISTMAS Cards! Jobbers' Prices! Fifty different items from 18c to 38c per box. Gift Wraps, Seals, Christmas Tree Windows, Books, Letterheads. Illustrated Catalog Free! Fantus, 436 North Wells, Chicago.

ADVERTISING book matches—Cash in on big demand—sell Union Label matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low prices—protection guaranteed on repeat orders—Cash commissions. Superior Match Co., Dept. P-98, 7530 Greenwood, Chicago.

POCKET Pal: Replaces Knives. New, Safe, Beautiful. Always razor sharp. 50c seller. 321% profit. $15.00 or more daily. Agents, Salesmen, Distributors. Sample 25c. Nelson Mfg. Co., 222 W. Kellogg, St. Paul 2, Minn.

EARN Big Money Year 'round. Be a one-person-department-store. Take orders for shirts, ties, hosiery, lingerie, Household linens, etc. For information Corporative Merchandisers, Dept. PS-6, 110 West 34th Street, N.Y.C. 1.

BE renewal headquarters for all magazines. Christmas gift sales starting now. Big profits. No experience. No capital needed. Free Catalog tells how. Write: McGregor Magazine Agency, Dept. 13, Mount Morris, Illinois.

HOT Items for Hardware dealers. Drop shipments. Farm Products, M-2019, Excelsior Springs, Mo.

EASY cash yours—steady, quick. Sell friends quality Nylon hosiery, lingerie, blouses. Free displays. Complete line greeting cards. Leader Christmas assortment on approval. Special outfit offers. Wear Wright Company, 1709 Arch St., Dept. B, Philadelphia, Pa.

INFORMATION — Wholesale supply sources. Moneymaking plans. Increase your income. Write Reynard Station, Smithfield 3, Ohio.

SILVER Plating Liquid—(NuSilver). Anyone can apply with cloth. Durable, guaranteed, genuine silver finish. Renews silverplated ware, articles, pieces. Silverplates brass, copper. Sales-Distributors wanted, exclusive. NuProcess Products, Aurora, Ill.

SCHOOL Seniors—Earn 40% commission selling classmates America's most beautiful Graduation Name Cards. Largest Selection. Outsells all others. Free Sample Kit. Printcraft, Dept. P, 1425 E. Elm St., Scranton 5, Pa.

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For Free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

GOLD lacquered Window Sign Letters. Large Sizes Penny Each. New Foils. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

SELL ultra-blue stock signs to stores, 1000 slogans, comedy, general, religious. "7x11" cost 6c—Sells 35c—Make money. 15 samples Ultra-blue signs "7x11"—$1.00 postpaid. L. Lowy, 8 West Broadway, Dept. 415, New York City 7.

ENTIRELY new—entirely different specialized men's shoe line. Advance commissions to $2.50. Bonuses, personal discounts. Free selling kit. Concordian Shoes, P-1, West Concord, Mass.

FREE nylons given if Kendex hosiery runs or snags! World's only women's hosiery sold with a written guarantee that amazes everybody. Mere words could not possibly express the almost unbelievable opportunity you now have to make money. Fantastic and "impossible" earnings now become a reality. Can you imagine a guarantee that replaces hosiery regardless if damage is due to use or abuse and regardless whether it is the fault of the hose or the wearer? Here is sales dynamite that will blast your earnings to the sky! Even if you never sold a thing in your life, three magic words: "Guaranteed Against Everything" will open doors for you—will make women listen and will pour money in your pocket. Kendex stockings are not sold in stores, so you have no competition. Complete line includes beautiful sheer nylons; long wearing, durable service nylons; three different lengths; genuine outsize nylons; latest shades; choice of full fashioned with seams or seamless; lowest priced rayons. Also separate complete line of men's hosiery including nylon, lisle, rayon, cotton, mixtures, etc.; plain and fancy; long and short. Thousands of pairs shipped daily. No money or experience needed. Nothing to invest or risk. No samples to buy. Nothing to pay, now or later! Simply write orders. We deliver and collect. Liberal advance cash plus huge cash bonus. Write orders spare or full time; exclusively or as a side line. Become a manager and appoint others to sell for you with steady income on their sales! Complete money-making outfit, including sales books in colors, samples cut from actual hose, instructions, order blanks, etc. furnished free and prepaid. Rush name and address on postcard and start making money next week. Kendex Co., Babylon 166, N. Y.

LOOK here! Wanted—Men to start in business on our capital. Sell some 200 farm-home Products. Thousands our Dealers now make quick sales, big profits. For particulars write Rawleigh's, Dept. I-192-PSC, Freeport, Ill.

SOLVE your money problems. Sell friends 50 and 25 for $1.00, 25 for $1.95 Name Imprinted Christmas Cards—free sample portfolios. 32 different boxes. Profits to 100%. Bonus. Feature Christmas, All-Occasion assortments on approval. Special offers. Write Pilgrim Greeting Card Co., 111 Summer, Dept. AJ-1, Boston, Mass.

MAKE money fast! Sell Christmas cards to friends, neighbors, others. Big variety Etchings, Religious, 50 for $1.00, Wrappings, Stationery. New $1.25 line "Little Ones." Flower Box, Plastic Frosteds, Saints 'n' Sinners. Special offers, bonus. Fund raising opportunity for individuals, clubs, churches, schools. Mail postal today for feature 21 card $1.00 Christmas assortment on approval. Hedenkamp, 343 Broadway, Dept. S-43, New York 13.

SELL Gold embossed monogram stationery. Sample free. Dunbars, Sanford, Fla.

EASY profits to 100%. Sell friends superior value 21-card $1.00 Christmas Assortment, 50 for $1.00 Personals, Everyday, Gift Wrappings, Stationery. Experience unnecessary. Request 1948's newest Super DeLuxe Christmas Assortment and Name Imprinted Christmas Card samples on approval. Holiday Card Co., 463 Congress St., Dept. MR, Portland, Maine.

$1 STARTS you in business. Sell lined ties, 100% wool interlining. Costs you only $7 per dozen, you make $5.00 dozen. Send $1.00 for special introductory offer two ties. Catalog complete line Free. Philip's Neckwear, 20 West 22nd St., Dept. P-26, New York 10.

SHINE Shoes Without "Polish." New Invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 126, Akron, Ohio.

NEW extra money plan. Make up to 100% profit—without experience—showing Christmas, Everyday Card assortments, Wrappings, Stationery, Coasters. Unusual, attractive. Bonus. Special offers. Send for free samples 30 different Name Imprinted Christmas Cards, 50 for $1.00, 25 for $1.00 and $2.00, Stationery, Coasters, Christmas, Everyday assortments on approval. Thomas Terry Studios, 90 Union Ave., Westfield, Mass.

$5.00 CASH advance commission every sale. 38-piece "Lady Ann" silverplate table service. Guaranteed quality, value brings sales galore. Sells for only $14.95, including tarnish-resistant chest. Bonus premiums. Write for Free Outfit. Dexter Silver Co., 303 Fifth Ave., Dept. PS-9, New York.

AMAZING offer—$40 is yours for selling only 50 boxes, each containing 25 new, entirely different DeLuxe Christmas cards with or without name imprinted. Also 50 for $1.00. Free samples. Other boxes on approval. Write today. It costs nothing to try. Cheerful Card Co., 414 White Plains, N. Y.

QUICK cash. Sell friends wonder value name imprinted Christmas Cards 50 for $1.00 up to 25 for $2.50. 43 sensational money makers. Up to 100% profit. Bonus. Special offers. Write for 9 Free self-selling sample portfolios name imprinted Christmas Cards and Stationery. Rainbow Greeting Card Co., 38 East 1st St., Dept. 18-B, New York.

BIG, easy profits to 100% selling new, novel Christmas Card. Gift Wrapping. Panorama. Christmas Carol assortments. Bonus. Special offers. Request free samples 50 for $1.00 Personals, Silver Imprint line, Name Imprinted and Floral Stationery and Feature Christmas samples on approval. New England Art Publishers, North Abington 249, Mass.

AT last! Something new and sensational in Christmas Cards. Gorgeous satin, velour designs never before offered. Amazing value! Gets orders fast. Name-imprinted Christmas Cards, 50 for $1 up. Big Profits. 30 other assortments 60c to $1. Imprinted Stationery. Samples on Approval. Puro Co., 2801 Locust, Dept. 841-L, St.-Louis, Mo.

I'LL Put A "Shoe Store Business" In Your Pocket! Nation's Leader trains you to make Big Money! Fit men, women. Free Sample Outfit—Write Today! Victor Thomas Shoe Co., Dept. V-163, Chippewa Falls, Wis.

EVERY housewife a prospect for automatic Speedi-Waxer. Send for details two big profit sales plans. Darby Corporation, Dept. 8S, 241 Centre St., New York 13, N. Y.

SPECTACULAR Guarantees, popular prices, make selling easy. Biggest steady repeat profits selling Colt's famous men's, women's Guaranteed shoes, hosiery. Experience unnecessary. Free selling outfit. Colt Shoes, 601-K9 Atlantic, Boston 10, Mass.

FREE Folder Patented Household Specialty. Flinsen, Box 4333-B, Kansas City, Mo.

BUY thousands of nationally advertised products direct from manufacturers. Write for "Buy Direct and Save." Consumers Ass'n., 287-B Lebanon Ave., Mt. Lebanon, Pa.

WOULD you pay 3%—first $350 made? Color-illustrated book "505 Odd Successful Enterprises" free! Proven! Work at home, office. Expect something odd! Pacific, Oceanside, California.

PATENTED Flood Lights. Sell to theaters, lodges, auditoriums, schools, stores, homes. Literature free. Communications, Inc., 110 University, Seattle 1, Wash.

SCHOOL Seniors! Your postal will bring our wonder, Kwick-Sell Cardalog of popular Graduation Name Cards. Biggest profits!!! Only firm giving free souvenir chest and Card Case. Don't miss out! Hurry that postal!!! Craftcards, Box 235(M), Pittsburgh 30, Pennsylvania.

STEEL Hook Clips 1⅝" x ½". 1000—60c. Samples. Standard, 65 Duane, New York 7.

AGENTS wanted for our coin operated amusement and slot machines in every town and community. Sell—or start your own route. Big profits! Write for free wholesale catalog and deal. Aerobilt Products Co., Dept. 26, Box 3767, Baltimore 17, Maryland.

SELL New-Used clothing from home, auto, store. Men's suits $1.25. Leather Jackets 85c. Overcoats 56c. Dresses 18c. Ladies coats 38c. Other Bargains. Catalog Free. S&N, 565A Roosevelt, Chicago.

AGENTS—Salesmen—Fast seller—New—Different. Every woman needs—waiting to buy. Mr. F. made $304.20 in 3 days. Selling like wildfire. Sample furnished. Boulevard Art, 75-MB West VanBuren, Chicago.

SEWING Machine Electrification Kit. Nationall advertised guaranteed product. Unusual opportunity for right men. Potential earnings unlimited. For complete details write today to Brownell Co., 308 Canal St., New York 13, N. Y.

QUICK Cash. Salesmen, make $10.00—$15.00 daily with only six shoe sales. Good future, liberal bonus. Invest nothing. Experience unnecessary. Over 60 styles. Free outfit. Merritt Shoes, S-3, Brockton, Mass.

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SELL famous $3 "Fire-Killer" extinguisher with bracket, wholesale or direct; exclusive territory. "Fire-Killer," Syracuse 1, N. Y.

63 HIGHGRADE SALESMEN

START your own business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual Sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh's, Dept. I-U-PSC, Freeport, Ill.

MAKE $15.00 to $25.00 per day. Joe Louis' and Marva Louis' (his wife) toilet articles, cosmetics and other products for men and women are sensational. White people like them; colored people buy on sight. Perfumes, powders, pomades, creams, brown creams, flavors, remedies, and many other fast sellers are our features. $3.95 buys $10.03 (23 items) retail deal—send $1.00, pay postman balance. Be first in your community to offer this new line and you will be happy. Joe Louis Products Company, 6 E. Garfield Blvd., Dept. PS-9, Chicago 15, Illinois.

SILVER Plating Liquid—(NuSilver). Anyone can apply with cloth. Durable, guaranteed, genuine silver finish. Renews silverplated ware, articles, pieces. Silverplates brass, copper. Sales-Distributors wanted, exclusive. NuProcess Products, Aurora, Illinois.

BRAND New!! Revolutionary Products!! Salesmen make $10,000 yearly selling one complete lighting line. "Neo-Glo" Fluorescent changeable message sign replacing neon. "All-Lite" Table lamp using upright fluorescent tube, spectacular "Circline" fixtures using circular tube. Verticals, Dual-Rays, Pin-Up Lamps, a complete line of fluorescent and incandescent fixtures covering every commercial, industrial, residential need. A triple sales plan insures your success whether you choose selling dealers, direct, straight commission or distributorship on our capital. Get set now with our growing progressive organization. To get you started, we will send a beautifully illustrated catalog showing over 200 profitable, sales-tested styles and models. Order blanks, sales helps, everything needed to start at once included. It costs you nothing. Rush name quickly—Today—and start making real money. Rose Company, 539-QQ South Franklin, Chicago, Illinois.

MAKE Easy Extra Money. Sell Christmas Cards. 9 Beautiful Lines 25 for $1. Name Imprinted Samples Free. Cyphers Card Company, 78 W. Huron, Buffalo, N. Y.

SALESMEN, Earn $100.00 weekly, selling only six pair shoes daily. Commission and bonus. Wide variety for men, women, children. No investment. Experience unnecessary. Tanners Shoes, 301 Boston, Mass.

ALL kinds American, Swiss watches, new and used; retail $3.65—$345.00; profit 33⅓% up; show our catalogue, get orders. Brookings, B-1975CJ, Little Rock, Ark.

BIG money selling fluorescent lighting fixtures for manufacturer in your territory. Complete line. Latest designs. Low prices. Free Outfit. National Lighting, PS4221 Harrison, Chicago.

67 EDUCATIONAL AND INSTRUCTION

HAVE your own office! Many earn up to $5,000-$15,000 Annually. Learn credit-collection agency business by home study course. Experience unnecessary. Write for Free bulletin. No obligation. Franklin Credit School, Dept. 203-J, Roanoke 7, Va.

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"UNCLE SAM" Jobs! Congress raises pay $330 to $450. Men-Women Qualify at home for examinations. 40-page book; sample lessons—Free. Write Franklin Institute, Dept. F-22, Rochester, N. Y.

USED Correspondence Courses and Educational Books Bought, Sold, Rented. Catalog Free. Educational Exchange, Summerville, Ga.

SPEED and Skill in Radio Code to qualify for Amateur or Commercial Radiotelegraph License. Learn at home with the famous Candler System used to train radiotelegraph experts and champions. Good pay or fascinating and profitable hobby. Free Book. Candler, Dept. 6-K, Box 928, Denver, Colo.

HOME Study course, drugless therapy. Free Literature. Inst. of Drugless Therapy, Tama, Iowa.

NATIONAL School of Foot Correction:—Juneau 2, Alaska. Extension. Degree. Details, 25c coin.

MEDICAL Laboratory Technicians in great demand. We train you in your own home, in your spare time. Also home study course in General Chemistry. Catalogue free. Imperial Technical Institute, Box 973-S, Austin, Texas.

JUNIOR College Diploma through Home Study. Liberal Arts and Christian Education. University Foundation, PS, St. Augustine, Florida.

FOR an extremely profitable lifetime business operate a Collection Agency-Credit Bureau. Easily learned. Free folder. Cole & Associates, Syracuse 2, New York.

WHY Don't You Write? Writing short stories, articles, etc., will enable you to earn extra money. In your spare time we teach you to write the way newspaper men learn—by writing. Free "Writing Aptitude Test" tells whether you possess the fundamental qualities essential to successful writing. Veterans: This course approved for Veterans' Training. Write today! Newspaper Institute of America, Suite 5668-P, One Park Ave., New York 16.

DEVELOP photographic mind by Supermemory. Write Thor Books, CS-9, Box 1210, Chicago.

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LEARN typewriter repairing under G.I. Bill. Adding Machine and Calculator courses available. For information write Dept. PS-9, Capitol School of Typewriter Mechanics, 1328 New York Avenue, N.W., Washington, D. C.

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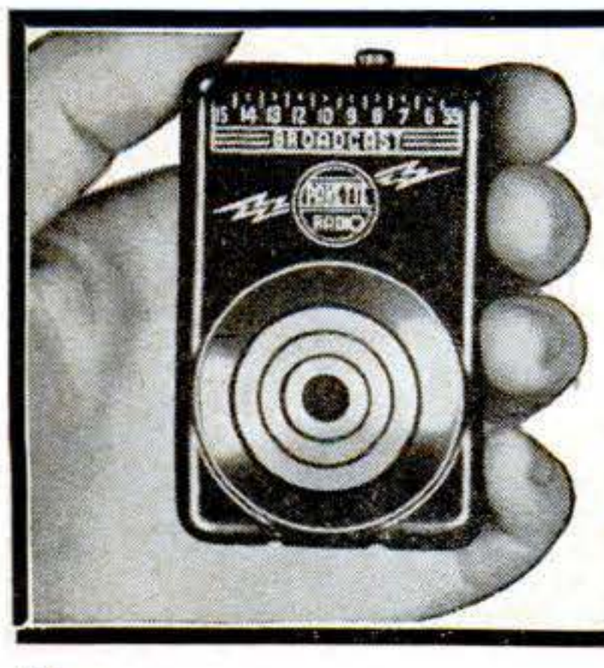

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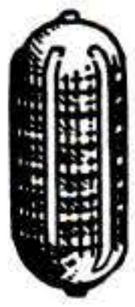

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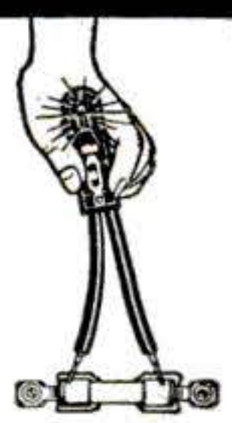

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New ARMY MINE DETECTOR

AN/PRS-1 is a portable device for detecting Metallic and Non-metallic objects. You can use them to ferret out all kinds of Buried-Treasures, in the Mountains or on the Beaches. Its private use suggests the following: In the hills or mountains, all types of Metals and Non-metals; on the beaches any type of objects such as jewelry and coins. For commercial use such as tracing buried cable, wire and sewer tile. Locating buried metal or wooden boundary stakes, etc.

TECHNICAL FEATURES:

This unit actually is a Ultra high Frequency transmitter. A variation in radiance resistance, caused by any change in soil density, shows in a deflection of the Microammeter, discriminating between Metallic or Non-metallic objects by a swing to the right or left. Audio response in the Headset also indicates changes by an increase or decrease in the volume of the 1000 cycle tone. By lengthening dipole rods operator will be able to increase the depth sensitivity.

This unit comes complete with spare tubes, antenna dipole and reflector, and instructions manual, in wooden chest 9½" height x 28¼" length x 15½" depth. Weight in operation is only 22 lbs. LESS Batteries. Power supply: Three 45 volt and one 6 volt batteries. Uses standard batteries. Original COST $285.00. Shipping Weight appr. 80 lbs. F.O.B., N. Y.

Our Special Price **$26.40** with battery
$17.50 without battery

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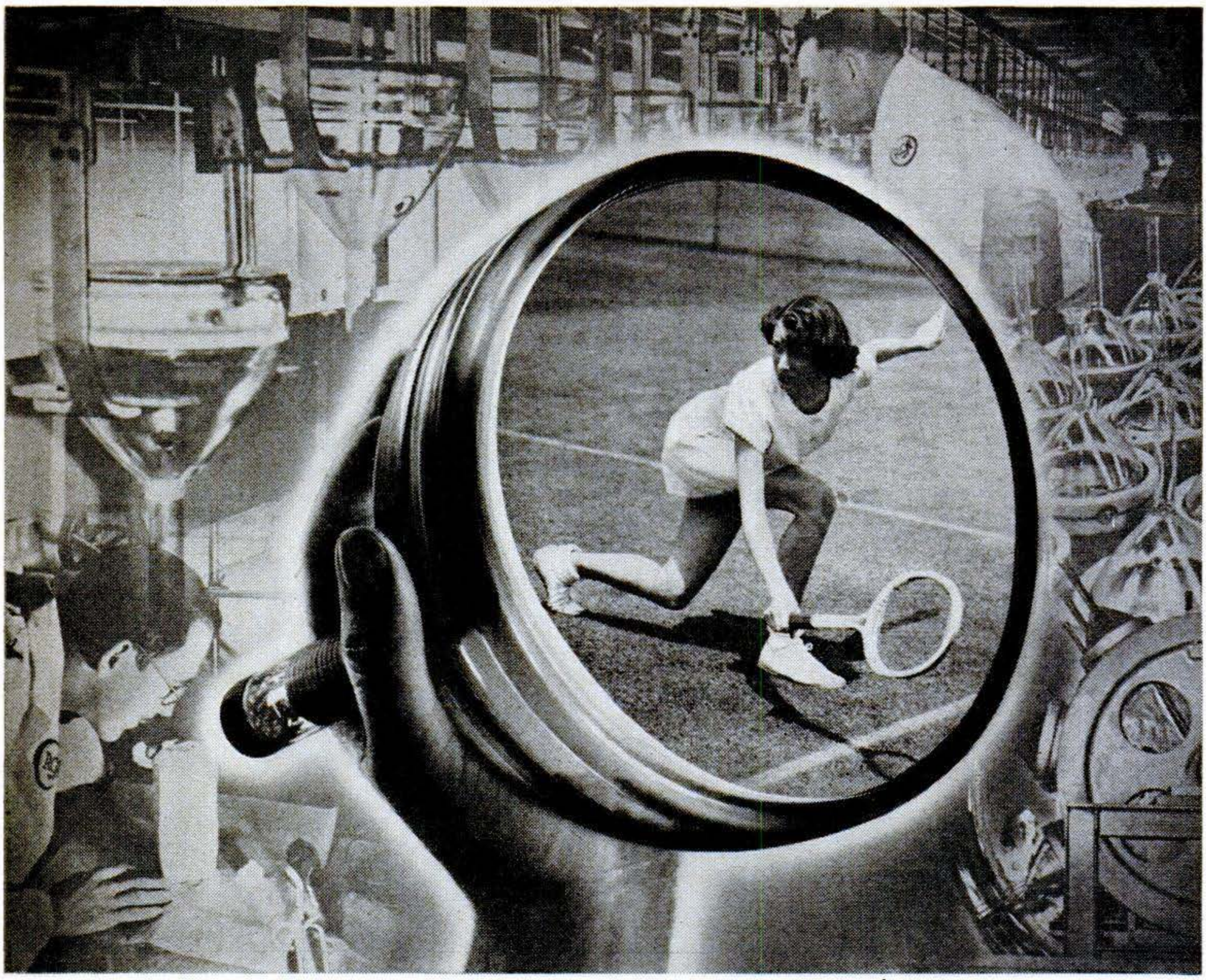

Machines in RCA's Lancaster Tube Plant are designed for mass production of Kinescopes—television picture tubes—at lowest possible cost.

Behind the magic of a Television Tube

Every morning, 14 tons of glass "bulbs" go down to the production lines at the RCA Tube Plant in Lancaster, Pa.

By evening, the bulbs are television picture tubes, their luminescent faces ready to glow—in television homes everywhere—with news, sports, entertainment, education, politics.

Born of glass, metals, chemicals, the picture tube comes to life through flame and heat. Its face is coated with fluorescent material—forming a screen on which an electron gun "paints" moving images.

Each step is so delicately handled that, although RCA craftsmen are working with fragile glass, breakage is less than 1%.

Water, twice-distilled, floats the fluorescent material into place on the face of the tube, where it clings by molecular attraction—as a uniform and perfect coating.

Every phase of manufacture conforms to scientific specifications established by RCA Laboratories. Result: Television tubes of highest perfection—assuring sharp, clear pictures on the screens of RCA Victor home television receivers.

• • •

When in Radio City, New York, be sure to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, New York 20.

RADIO CORPORATION of AMERICA

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Let's All Go Back to School....

THIS is the month the kids go back to school. It's easy, now, to think of education as the business of youth. But if you think so, tune in the nearest quiz program.

The answers to the simplest questions can make adult ignorance amusing. Yet it isn't really funny that plenty of parents know less about geography than their children. That so many of us with a bank balance have trouble with checkbook arithmetic. That so many drivers misunderstand automotive physics, let alone the nuclear variety.

The laugh, if any, is on us. Because there never was a time when public understanding was more vital. Geography and physics are getting to be a very personal, as well as political, affair.

It would do us all good to go back to school. Not as pupils to clutter up the crowded classrooms, but as visitors taking a quick refresher course in the scholastic attitude. To rediscover that education is a *process* that never ends.

An hour in the back of the room might inspire many to continue the process. To be sure, your education didn't stop cold with your schooling. Books, museums, and magazines (like this one) have had their effect. But how much do you know of the programs for adult education in your own community?

Your local high school may have evening lectures in art or atomics more entertaining than plenty of movies. Most big cities offer opportunities that cost little more than your time. Many small towns have discussion groups—and the healthy argument that lubricates learning. Modern correspondence courses are tailored to most usual and some unusual interests.

Certainly you will find that education for grown-ups is more fun than you realized. Who knows—you might even win a prize on a quiz program!

Perry Gilkeys

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IN AN F-80 BUILT FOR TWO

THIS is the TF-80C. Like its fighter counterpart, the F-80, it is fast, sleek, jet-propelled. But there is one important difference. *The TF-80C is a two-seater!* It's a trainer-fighter (TF) — the Air Force's first "jet" fully equipped for both instructor and student.

The new "Shooting Star" trainer will help speed jet training for Aviation Cadets. Instead of the usual "build up" in propeller-driven fighters, the student will be able to begin jet training as soon as he completes basic training. It means a safer, more interesting training program.

The TF-80C is powered by the same engine and has the same general features as the standard F-80B. The fuselage, however, is three feet longer and contains two completely instrumented cockpits. The instructor sits in the front seat, may switch off the dual controls in the student's cockpit at any time.

Young men who choose careers in the U. S. Air Force share in the training advantages of projects such as this. You'll have a chance to learn more of these benefits on Air Force Day — September 18.

Attend the Air Force Day events in your community or at your nearest Air Force Base. It will be a good opportunity to find out about the Aviation Cadets. Learn how you can qualify and make an appointment to take your examinations for pilot training.

U. S. Army and U. S. Air Force Recruiting Service

★

AIR FORCE DAY IS SEPTEMBER 18, 1948

★

AIR POWER US AF IS PEACE POWER

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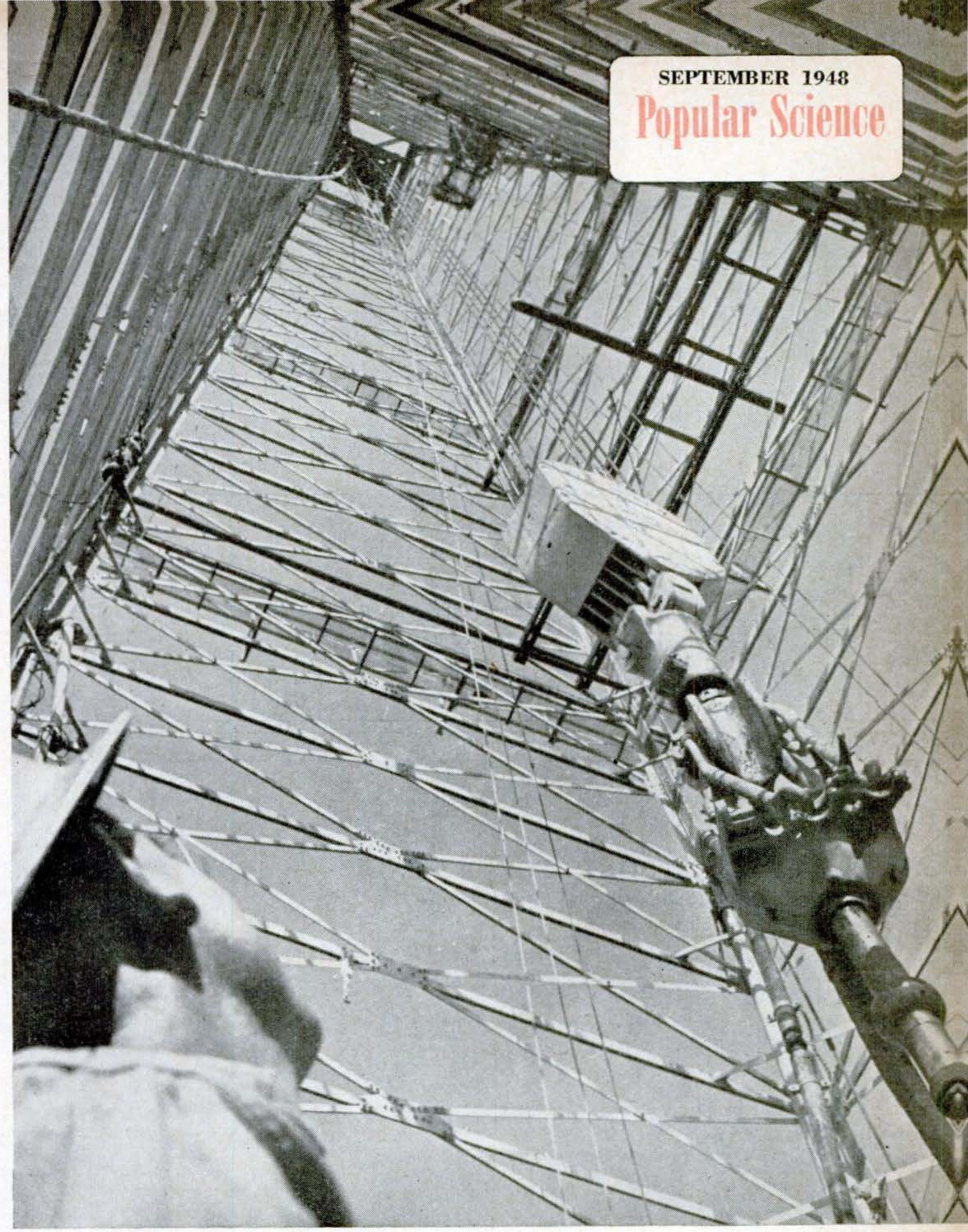

SEPTEMBER 1948
Popular Science

Inside Looking Up . . . It's 18 stories to the top of the web of steel forming the world's largest marine oil rig. Mounted on a movable barge, the derrick speeds up drilling of underwater wells to a depth of 18,000 feet. Main advantage of the rig's towering 186 feet is faster and easier handling of the 18,000 feet of drill pipe that can be accommodated in its racks. Capable of lifting nearly a million pounds, the derrick is so big that the operators keep in touch over an intercom system. Its 5 boilers generate 2,250 hp.

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Cover by Reynold Brown

How Dual-Fuels Pep Up Cars

By R. P. Stevenson

"Octane overdrives" save high-test gas by giving engines peak power only when needed.

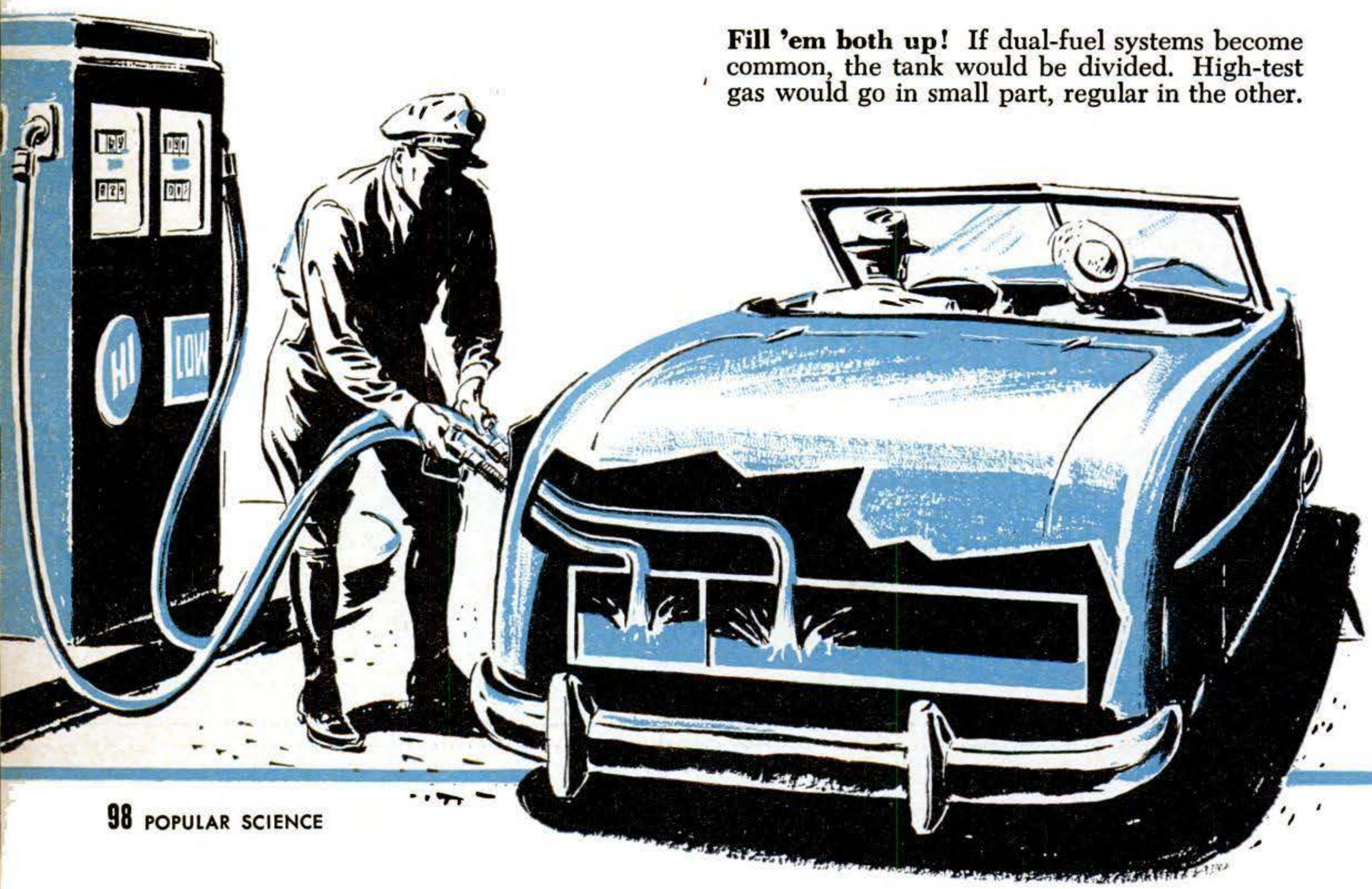
YOU'VE been wasting gas. No matter how lean your mixture or how gently you tap the throttle, part of your gasoline dollar has been dribbling uselessly out of your exhaust pipe.

It's not your fault. It's simply that even the best auto engines now made don't take full advantage of the fuel you feed them. They need high-octane quality only a fraction of the time, yet they burn the extra quality all the time.

This wasted *quality* didn't matter when gas was cheap and quality was plentiful. But gas costs more and more. And increased demand—not only for gasoline, but for Diesel and fuel oils—has put a limit on the amount of high-test gas that can be made.

Auto engineers will tell you that engines with almost double present compression ratios are a very practical dream. They offer both efficiency and economy. But the trouble

Fill 'em both up! If dual-fuel systems become common, the tank would be divided. High-test gas would go in small part, regular in the other.



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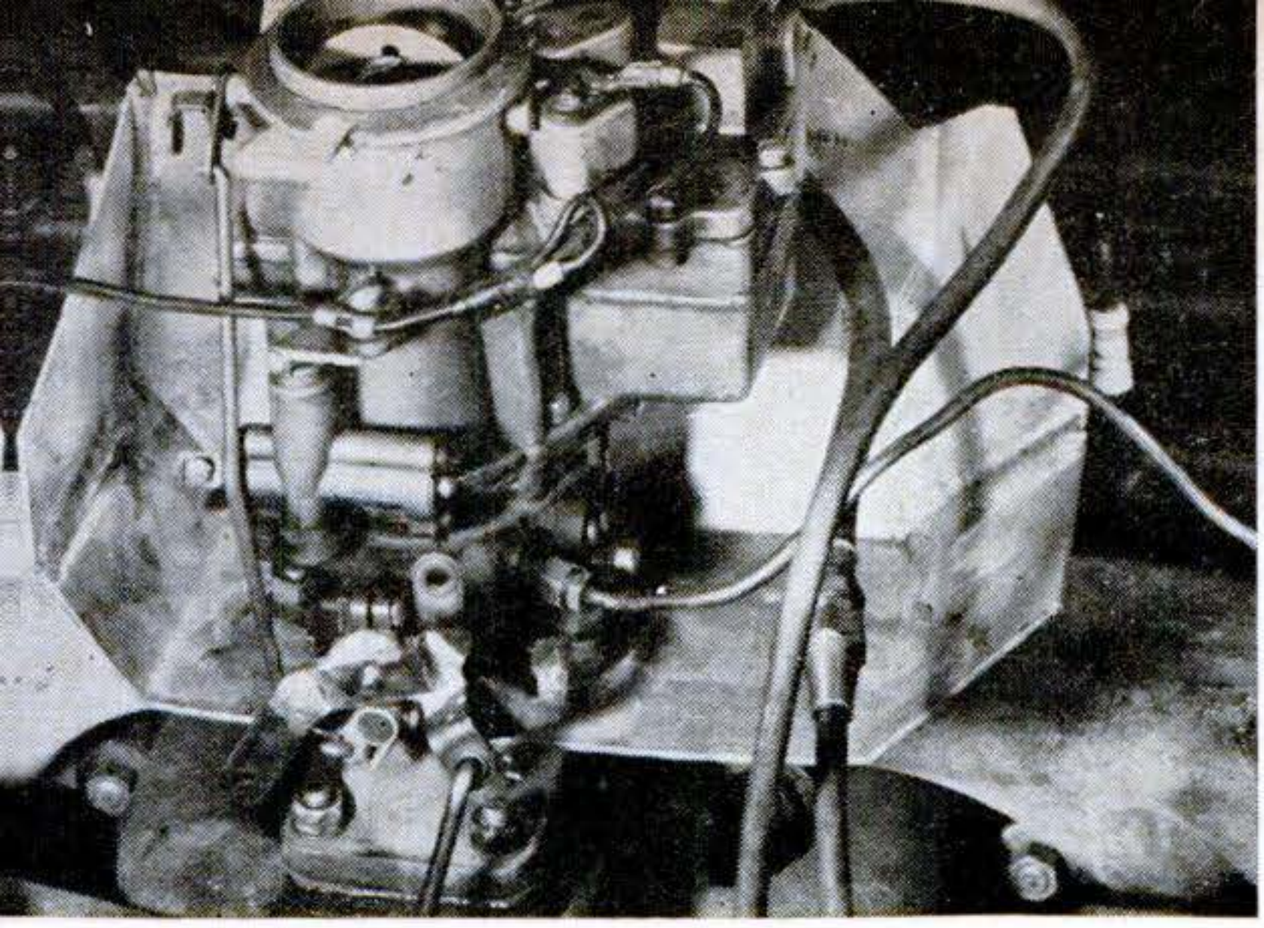
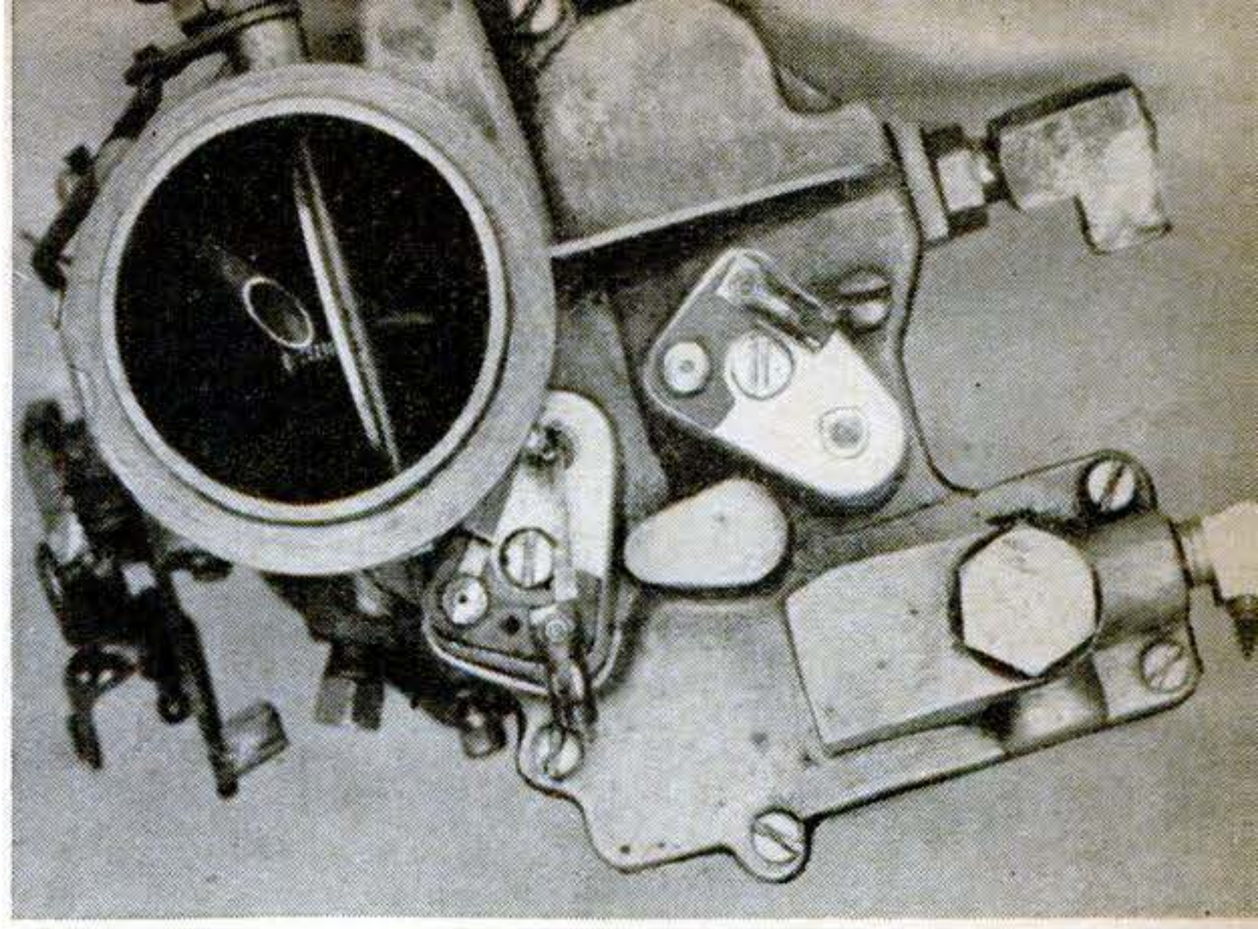


A two-bowl carburetor was developed for the dual-fuel experiments. Here it's installed on a Socony-Vacuum test car. A sheet-metal heat shield prevents vapor lock from exhaust heat.



Looking down on carburetor, you see low-octane inlet at right, the premium inlet above it at upper right. Below circular air horn is solenoid that helps change from one gas to other.

will be to get enough 100-octane to feed them. One such super-engine with a rumored ratio of 12 or 14 to 1 has already been cut to 9 to 1.

Any increase in compression above the present top ratio of 7 to 1 can't come too fast. In the past, it has cost the refining industry millions of dollars to add a single octane number to gasoline. Today costs are even higher. To boost production of premium gas above the present 85-octane also means more steel and crude production.

These are the conditions that have forced some brand-new thinking in automotive circles. Right now, refiners, carburetor and car makers, fleet operators, and others are testing developments ranging from dual-fuel systems to economy gadgets that can be hooked onto present cars.

Some of these developments will have to be engineered into cars not yet designed. Others are now in use in limited areas. All have one thing in common: a way of keeping an automobile on a low-calory diet by giving it a shot of pep only when pep is needed.

When you first start up, when you are going up hill, when you step out on the level—these are the only times your engine really needs the extra octane numbers it gulps all the time. Under average driving conditions, these peaks total only a fifth of the time the engine is running.

A dual-fuel system solves this problem automatically. You don't do anything but step on the gas. No push-pull, no switch-twist. The Socony-Vacuum experimental car I drove looked—and acted—like any other of the same make. But under the hood there were two complete gasoline systems, ending in a double-bowl carburetor that squirted high- or low-octane through a common jet.

Lights Tell What's Happening

Mounted on a special panel on the dash were two small lights, one green and one red, with a vacuum gauge between. The lights were wired so the green would glow when the engine was using low-octane, red when it was getting premium.

When the motor was started, the red lamp came on briefly, but soon gave way to the green. The red took another turn as I accelerated for the getaway—but not for long.

Very soon we again had the green light, the low-octane indicator, and it remained

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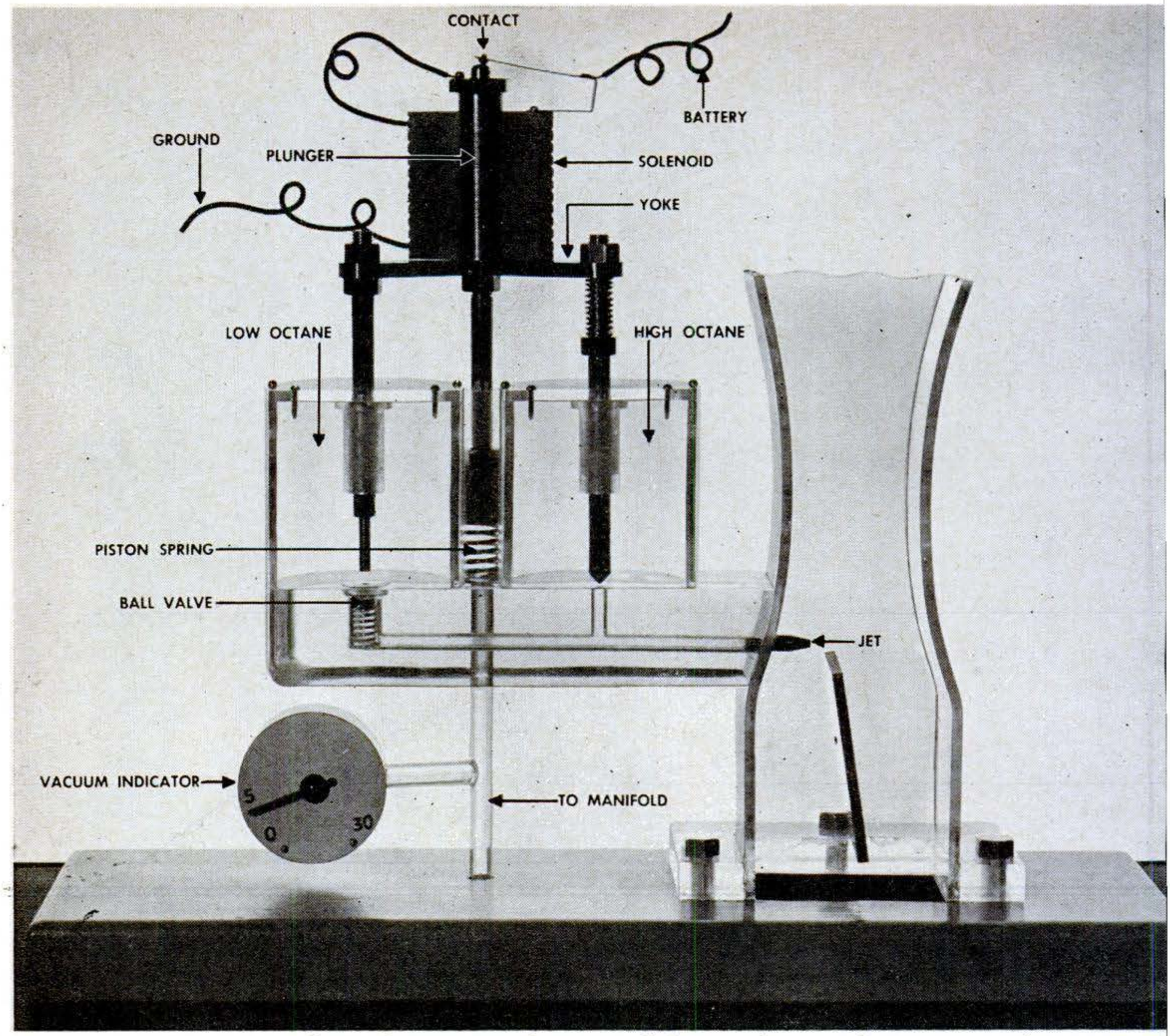

This schematic model indicates basic parts of the two-bowl carburetor. An accelerating pump that feeds fuel from the high-octane bowl was omitted for simplicity. The vacuum indicator is merely for illustrative purposes. For operation of the carburetor, see the facing page.

shining as we drove a mile or so at normal cruising speeds.

Then I began putting the system through its paces. After slowing almost to a crawl, I abruptly stepped on the accelerator. The vacuum-gauge needle swung toward zero and the red light came on.

Alternately slowing and hitting the accelerator, I soon had the vacuum needle in a crazy dance and the red and green lights winking.

But the engine performed perfectly. When it demanded high-octane gas, it got it. When the lower grade was all it needed, the engine was satisfied. There was no confusing the system. It seemed almost human.

Both Socony-Vacuum and Ethyl Laboratories are experimenting with dual-fuel systems. Results will be turned over to the manufacturers for possible incorporation in the new models you'll be buying a few years from now.

Eventually, if this program works out, you'll drive your new car up to a double pump. The attendant will stick two hoses into your double tank. And for every four gallons of ordinary gas a gallon of premium grade will be delivered.

The heart of the dual-fuel system is a double-bowl carburetor designed by Carter. Up to now, carburetors have been beautiful little machines for precisely measuring out the *quantity* of gasoline demanded by conditions. The new carburetor adds the new dimension of *quality*.

To illustrate the ingenious mechanism by

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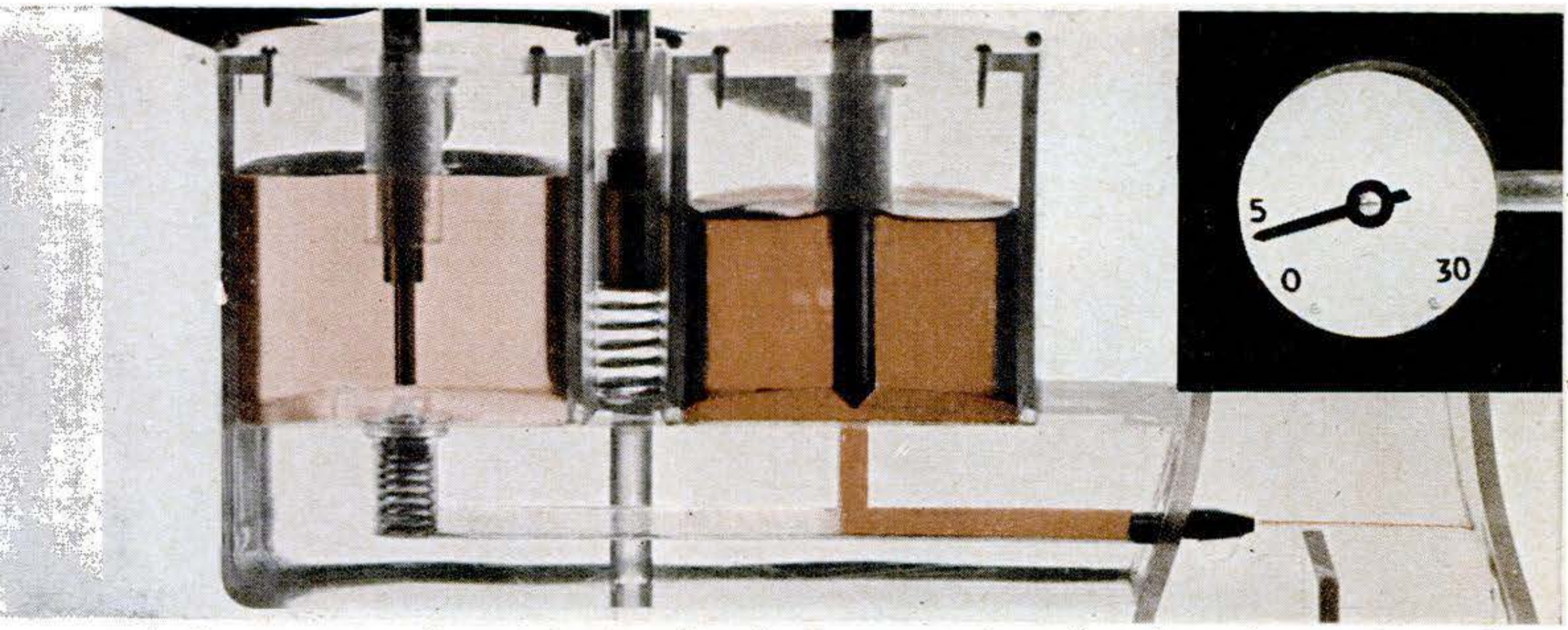
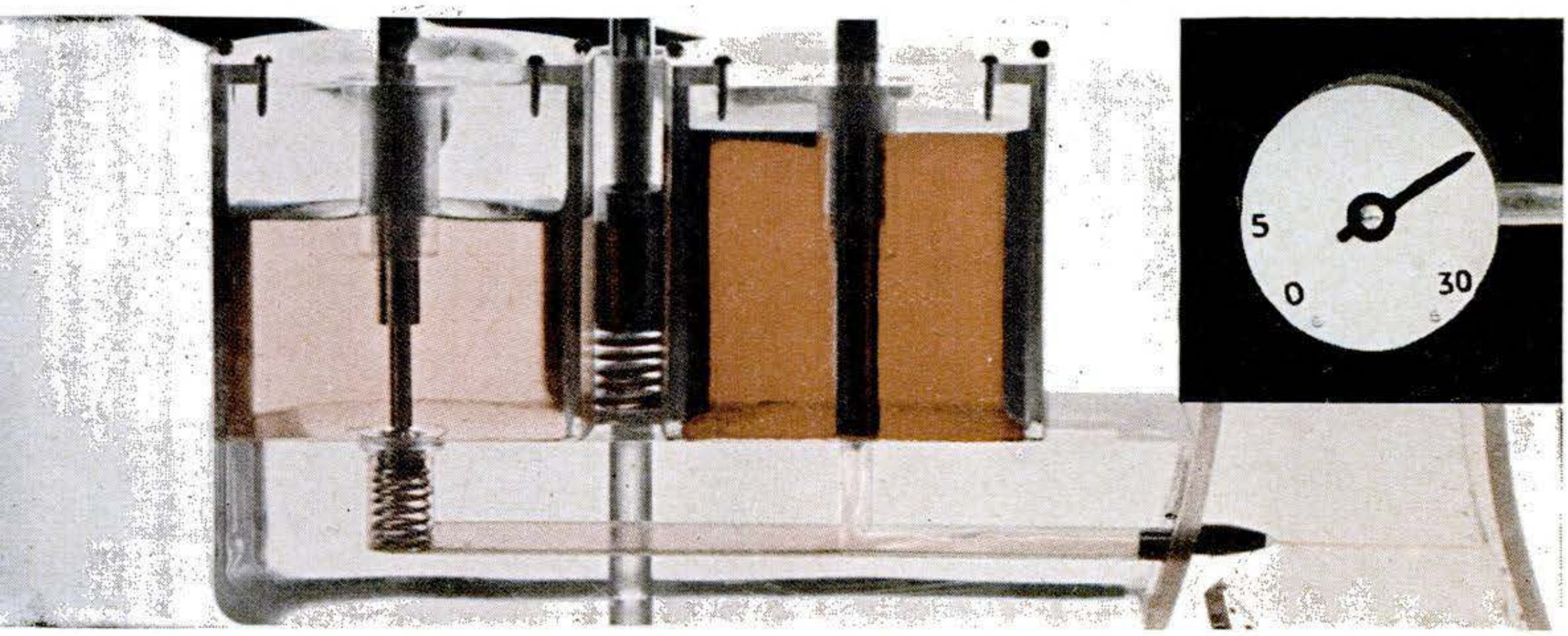


At low vacuum, when engine is pulling hard, spring has shoved up piston, plunger has closed solenoid contact, and this magnetized coil has snapped up the valve yoke. As shown above, this lets ball valve (left) close and opens needle valve (right). High-octane fuel now feeds engine.



At high vacuum, when engine is idling or running at part throttle, downward pull on piston has overcome spring, opening solenoid contact. Drawn by a second spring, the valve yoke has now dropped down. As shown, this shuts off high-octane (right) and admits the low (left).

which the carburetor shifts from one grade of gas to the other, POPULAR SCIENCE made and photographed an animated model of plastic and brass. Keep your eye on the pictures while we see just how this two-fisted fuel system works.

The changeover from one fuel to the other is instantaneous. A solenoid and a vacuum-operated piston, acting against a spring, do this part of the job. The tension of the spring determines at what manifold vacuum the change will take place. The manifold vacuum is low when the engine is working hard, and high when it is under no strain.

While the engine is stopped, there's of course no vacuum at all. This allows the spring to shove up the piston, closing a contact that leads to the solenoid.

As soon as the ignition is turned on, this solenoid is energized. It immediately draws up a metal plate, opening the high-octane valve and closing off the low-octane.

The engine starts and runs briefly on high-octane.

The predetermined changeover point is reached when the manifold vacuum pulls harder than the spring pushes. The piston is then drawn down, opening the low-octane valve and simultaneously closing the other.

During idle and part-throttle operation, the engine continues to use low-octane fuel.

Then perhaps you come to a steep hill—or step down hard on the accelerator for a quick pickup.

As the vacuum drops below the changeover point, the piston is pushed up by the

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Water injection is another way of conserving gasoline quality. In Cleveland, Yellow Cabs are now making a wholesale test of the Vitameter Ⓣ, an injector developed by the Thompson Products Co. Above, the 5-qt. tank of a cab is being filled with Vitol Ⓣ, an alcohol-water solution that's used in the injector. You'll be able to buy antiknock Vitol soon at gasoline stations.

spring and closes the magnetic-coil contact. The low-octane valve closes and high-octane feeds to the engine.

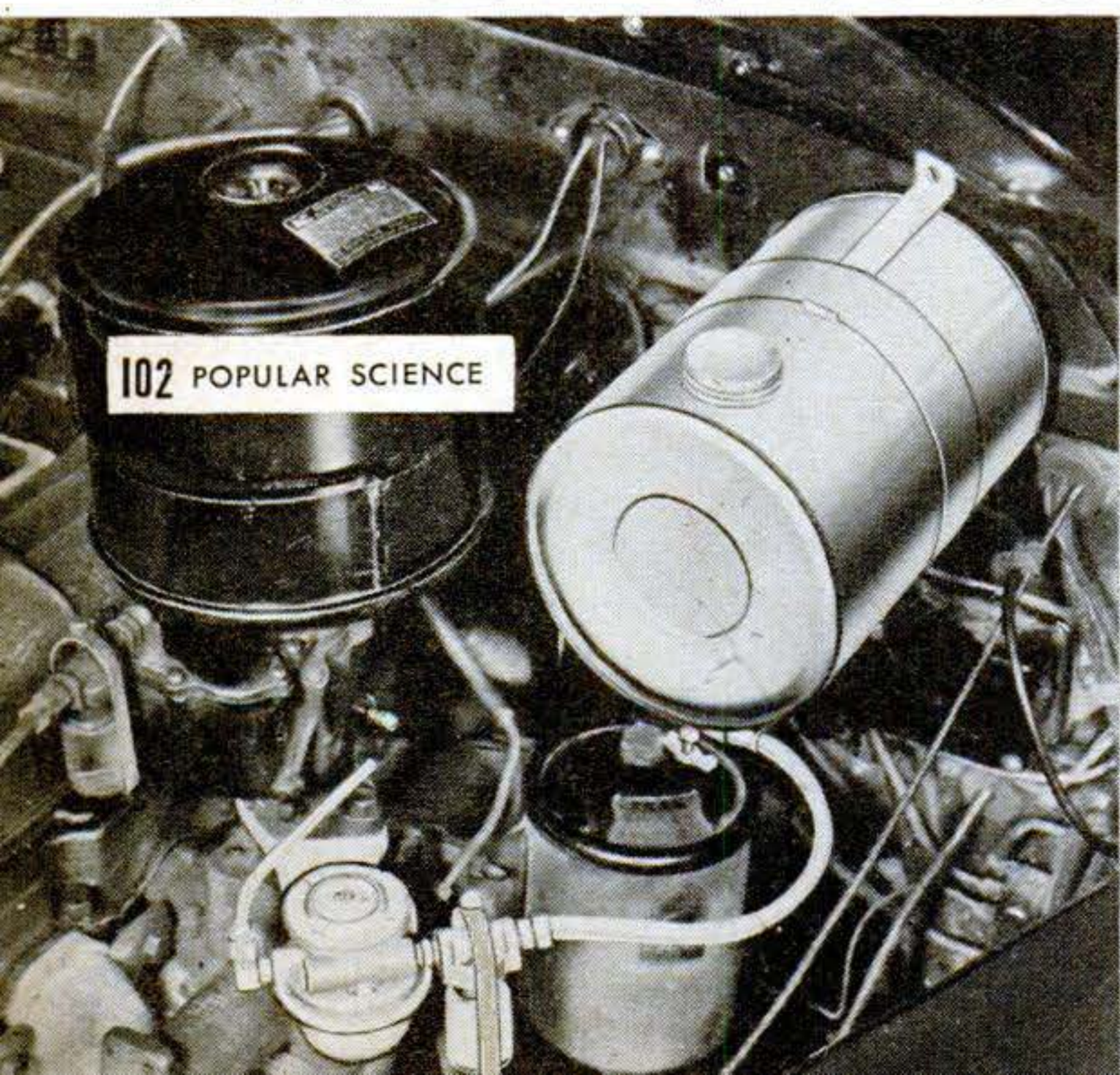
In Socony-Vacuum's test car, an electric pump delivers high-octane from a temporary tank, and the existing pump and tank are used for low-octane. In a production car, the dual-fuel system would have a double fuel pump.

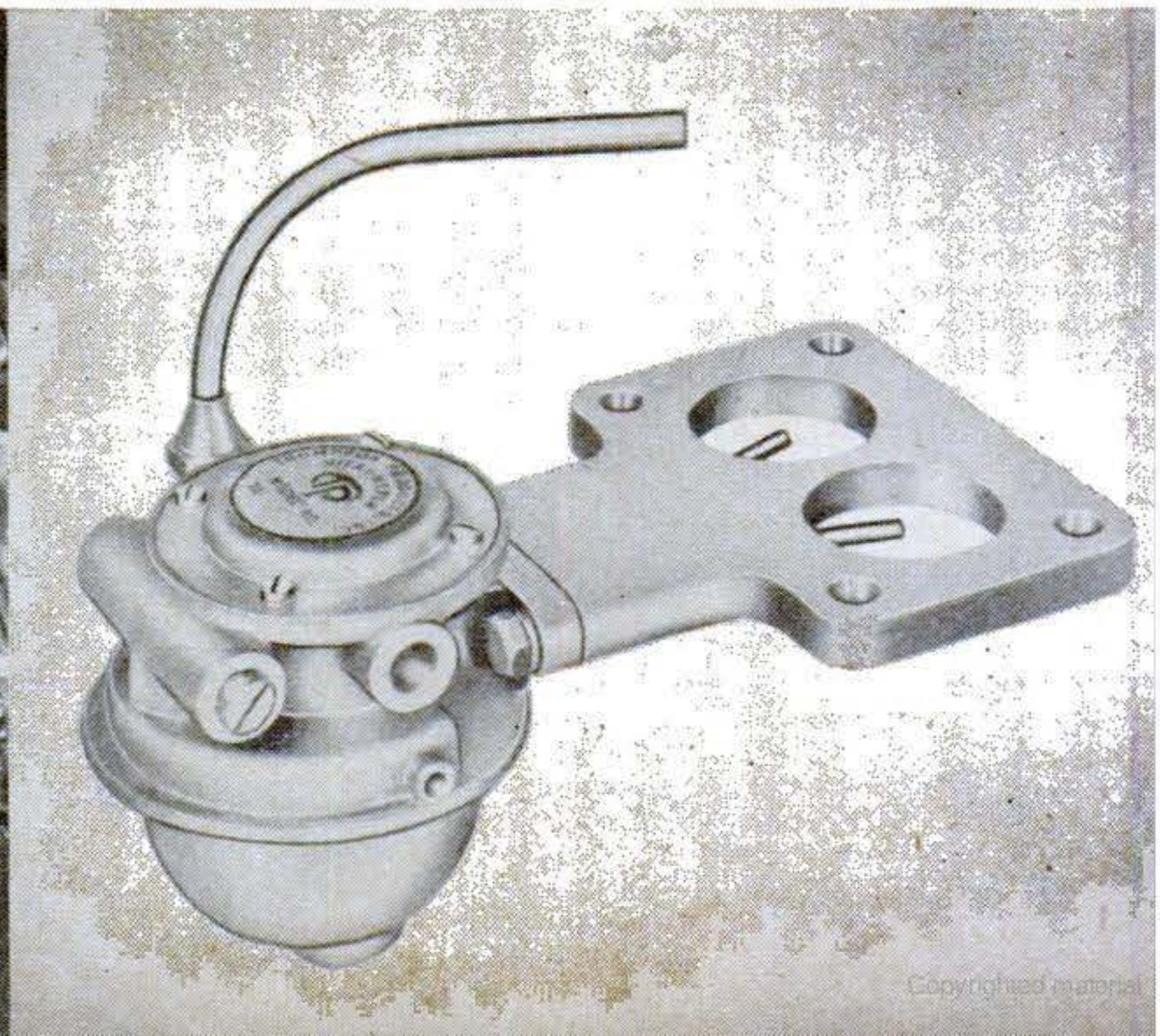
There's another way of shooting octane numbers into an engine for peak demands that is now being tried out. This method injects water or a water-alcohol solution into the fuel mixture.

Since last April, Yellow Cabs have been running around Cleveland on 58-octane gas. Under their hoods is an injector flamboyantly named the Vitameter Ⓣ but engineered and manufactured by Cleveland's conservative Thompson Products—makers of valves and donor of aviation's Thompson Trophy.

It has long been known that a water-

Vitameters, right below, are mounted, as shown at left, by means of a flange that fits between the carburetor and intake manifold. Notice the filter bowl in the line running from solution tank.





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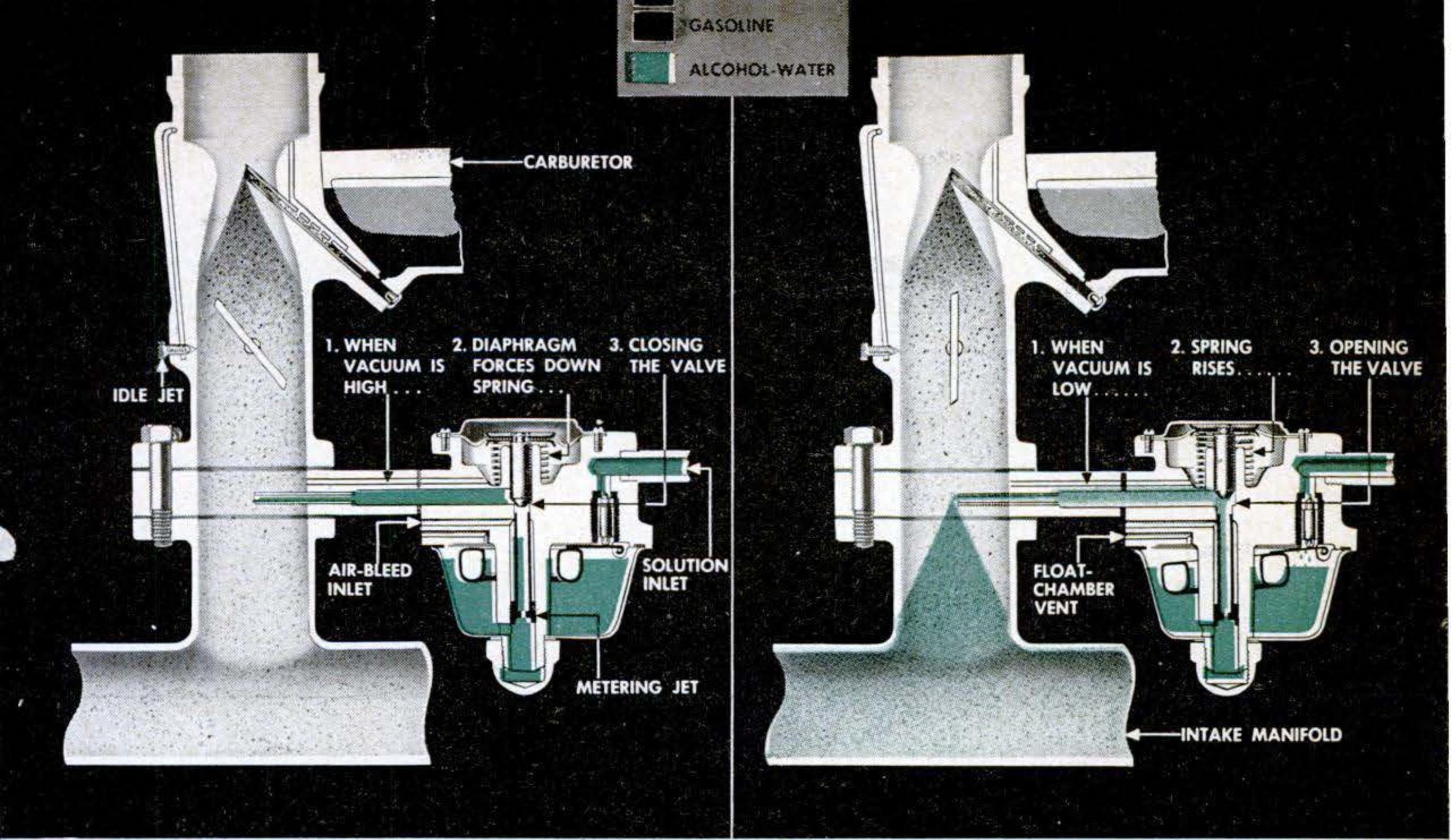

How Vitameter works. Manifold vacuum determines when injection will occur. You've often noticed that a windshield wiper slows down or stops when vacuum drops during times of full throttle. At these periods, the engine needs injection to prevent knocking. Because vacuum is low, the spring can open the valve. Spring tension is adjustable for different engines.

moistened fuel mixture gives an engine more pep. You've probably noticed this on rainy days, when the air that mixes with the fuel is moisture laden.

By keeping down the temperature of the explosive mixture, injected water promotes a more even explosion and prevents detonation—the annoying knocking or pinging that comes from your engine when it's pulling hard.

With injection, you can use lower-octane gas and still have no knocking. That's why the Cleveland cabs get by with a gas that stands at only 58 in the octane scale.

Gives Pep When Needed

The Thompson Vitameter is engineered to inject a water-alcohol solution only when your engine needs the pep this injection can give. In effect, it is another carburetor. Anti-knock fluid, held in a float bowl, is metered into the air-fuel mixture as needed. Once again, it's the intake manifold vacuum that determines when injection will occur.

If the engine is idling or operating at low throttle, high manifold vacuum closes the main valve and no fluid flows. As the throttle is opened wider, a diaphragm spring overcomes the slight force then exerted by the low manifold vacuum. The valve opens, allowing fluid to be injected. The point at which this occurs can be varied by adjusting the spring tension. Interchangeable jets of different sizes regulate the amount injected.

Thompson engineers report that injection has the effect of adding 10 to 20 octane numbers to the fuel that's being used. This opens up three interesting possibilities.

How Injector Can Be Used

When the proposed new high-compression engines appear, you could install a Vitameter and still use the present premium gas. This was demonstrated at a recent meeting of the Society of Automotive Engineers. The engine of the demonstration car had been souped up to a 9-to-1 compression. Normally, it would have required 100-octane fuel for knock-free performance. Yet with the Vitameter it showed no detonation on premium gas of about 85-octane.

Or take the case of a current car that requires premium gas. By installing an injector, you could use the more economical regular grade and raise its 76-octane rating well above the premium level. Besides economizing on gas, you would get all the other advantages claimed for injection.

Again, if your car operates satisfactorily

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on regular gas, you could install an injector and use a fuel of still lower octane rating. This means little to the average motorist, since refiners agree that it would be economically unfeasible to make a third grade of gas available at all service stations. But commercial fleets could buy third-grade fuel in tank-truck lots.

In fact, the Thompson company proposes that the big refiners supply fleet operators a special low-octane, straight-run gasoline to be known as Vitane Ⓣ. That's what the Cleveland cabs are using. Such gasoline can be produced at considerably less cost than cracked, blended, or reformed fuel—the type now available at gas stations.

Special Fluid Prevents Knocking

It's expected that gasoline stations will handle a special antiknock fluid to be used in the Vitameter. This will sell by the quart at about the price you pay for motor oil.

Called Vitol Ⓣ, the fluid consists of about 85 percent alcohol, 15 percent water, with 3 cc. of tetraethyl lead per gallon. It also has an inhibitor to keep rust from forming in the carburetion system.

Vitameters and Vitol will be available for passenger cars this year in part of Ohio. The territory will expand from there as rapidly as a supply of Vitol and service instructions can be made available. For most of the United States, this may not be before late in 1949.

Road tests in recent years have revealed some surprising results concerning octane requirements at different speeds and throttle openings. Both the Vitameter and dual-fuel system are based on these results.

Here's an example:

With the spark set for maximum economy, the experimenters found that fuels of only 20 to 30 octane number gave knock-free operations at low speeds on level roads.

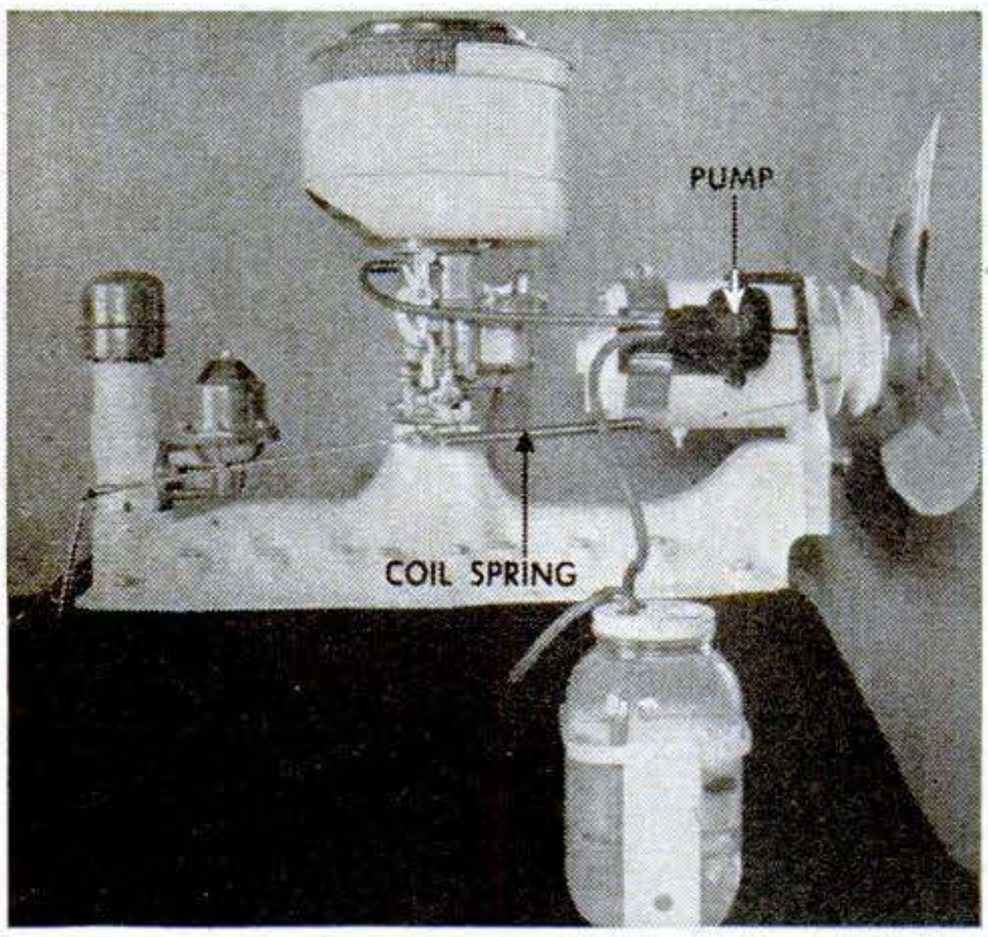
Even at 60 miles an hour at half-open throttles, a 45-octane gas was satisfactory. But for so-called "full-throttle" conditions —starting, hill climbing, and top speeds— the same car had to be given a 75- to 85-octane gas for satisfactory performance.

Dual-fuels are still in the experimental stage. Before they become a part of the package of transportation called "your car," they will have to meet the standards of volume production. The last hurdle will be, as always, testing in use by the public.

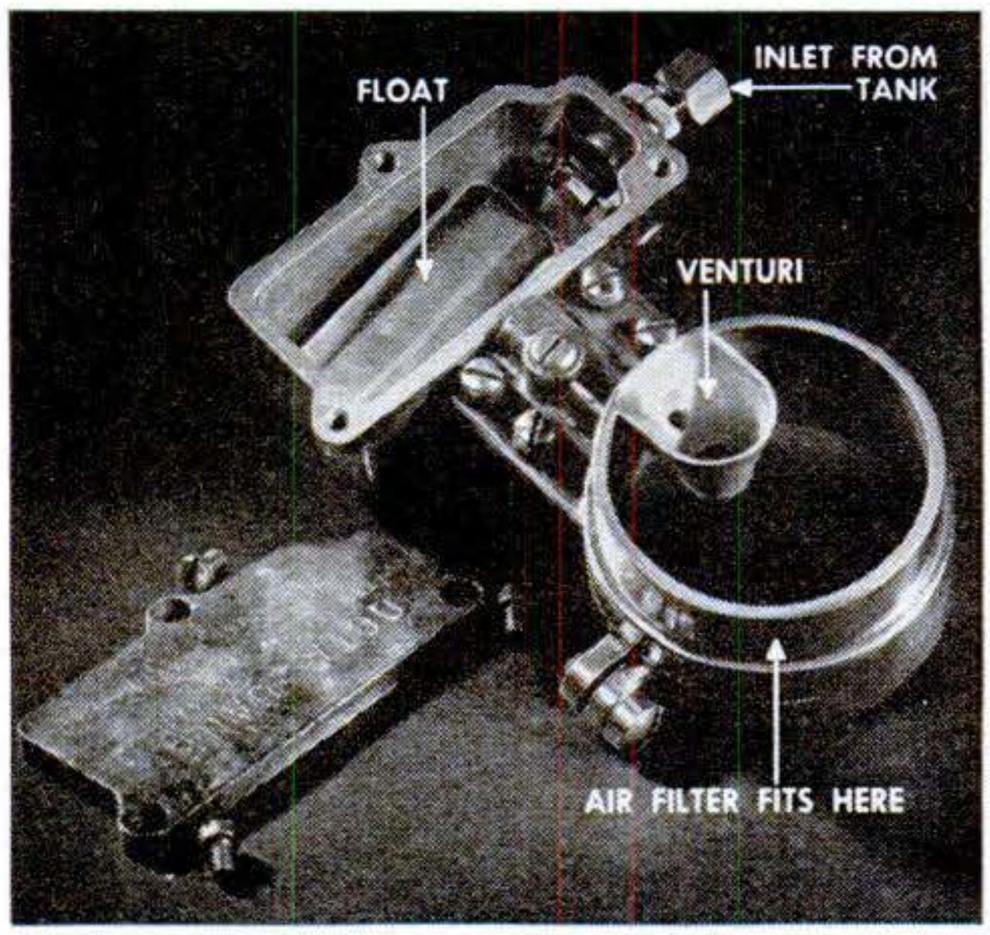
But as compression ratios creep upward, the need to conserve the limited octane numbers in every barrel of crude will push the development of dual-fuels.

You may be saying, "Fill them both up!" sooner than you think. END

Injectors on Market Give Power as Needed



Hydro-Jector Ⓣ. Made by Associated Laboratories, Cleveland, it pumps a shot of water into carburetor each time you press gas pedal. If you then keep pedal steady, a coil spring, linked to throttle, relaxes in a few seconds and injection stops.



Octa-Gane Ⓣ. A product of Continental Carburetion, Richmond, Calif., it works like a carburetor. A collar fits between the air filter and carburetor, bringing the Venturi within the air stream. Water feeds in proportion to air-stream speed.

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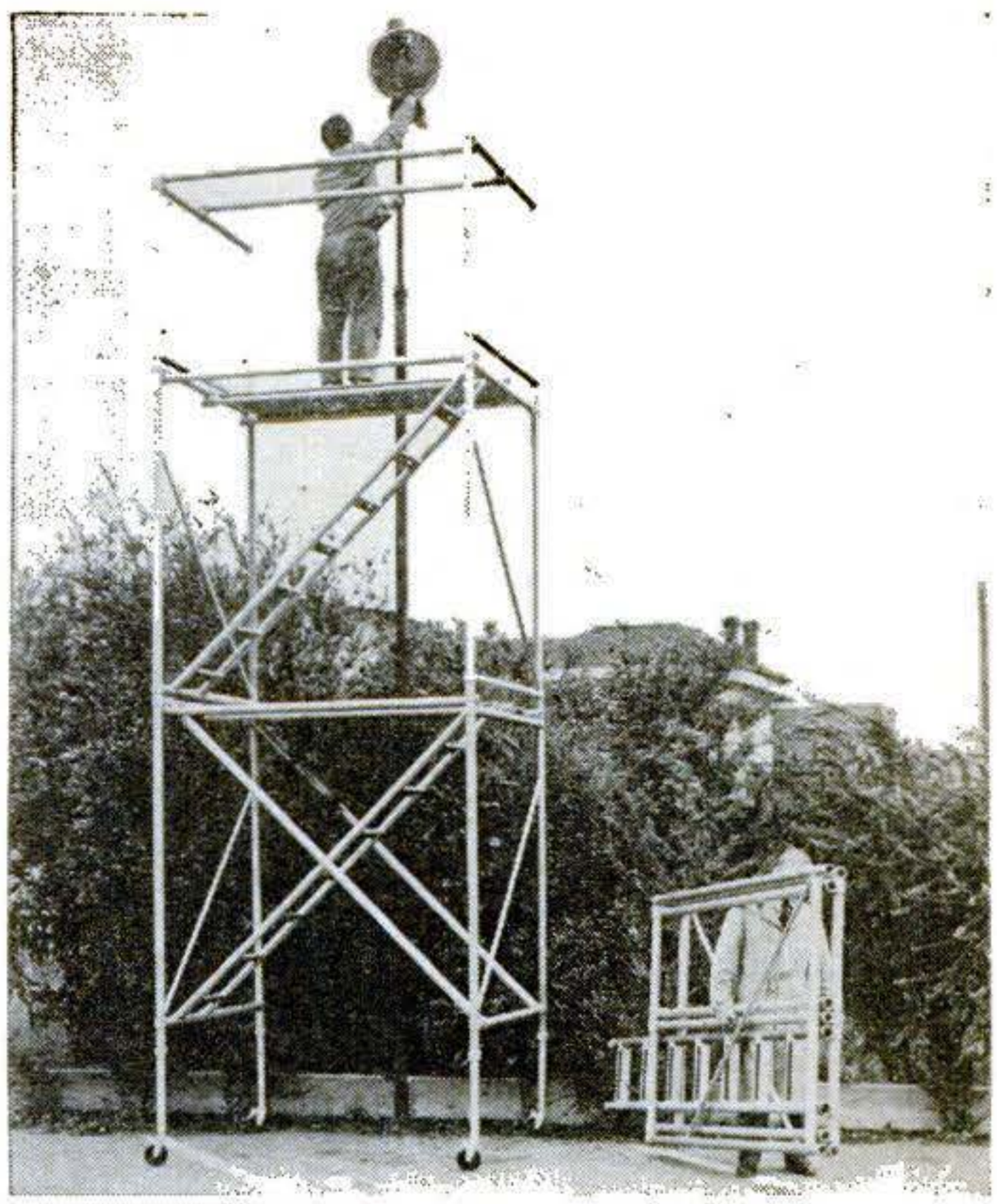
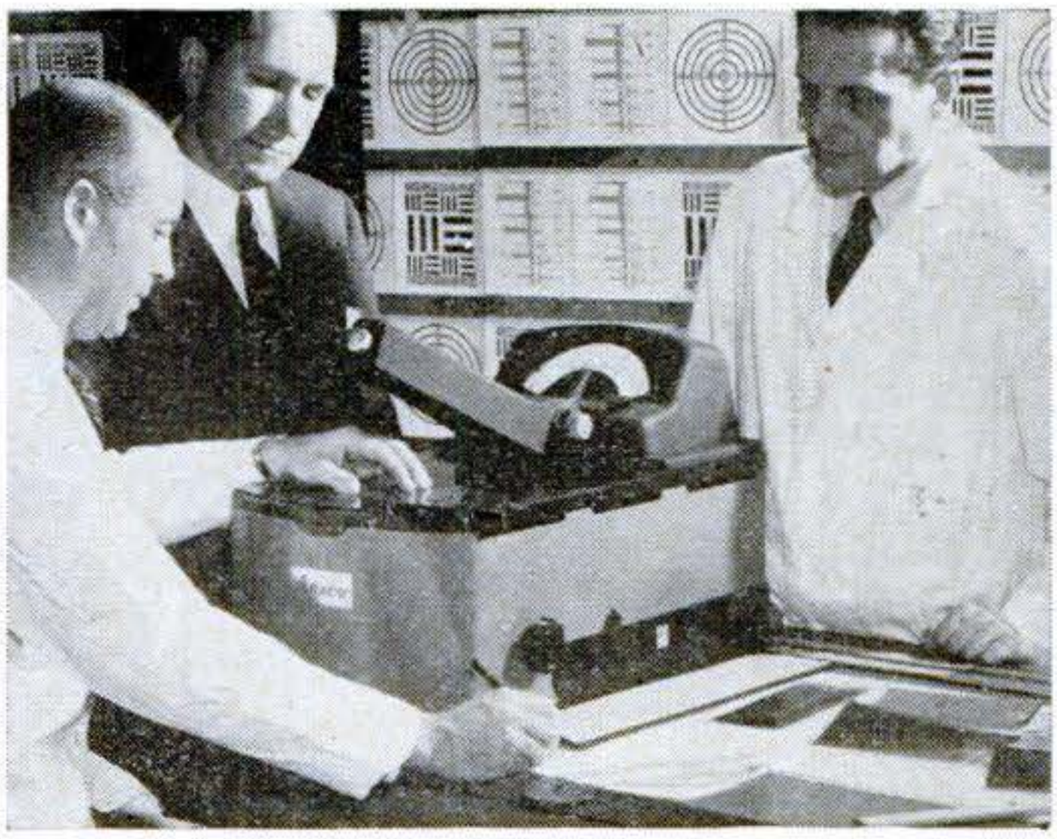
Knives Test Peas

A "TENDEROMETER," shown above, now takes the guesswork out of cooking peas for canning. It simply slices up a test batch with sharp knives and measures the force needed to cut through them. Patented by American Can Co., the tester has been made available, free of royalties, to commercial canners in the U. S. and Canada.



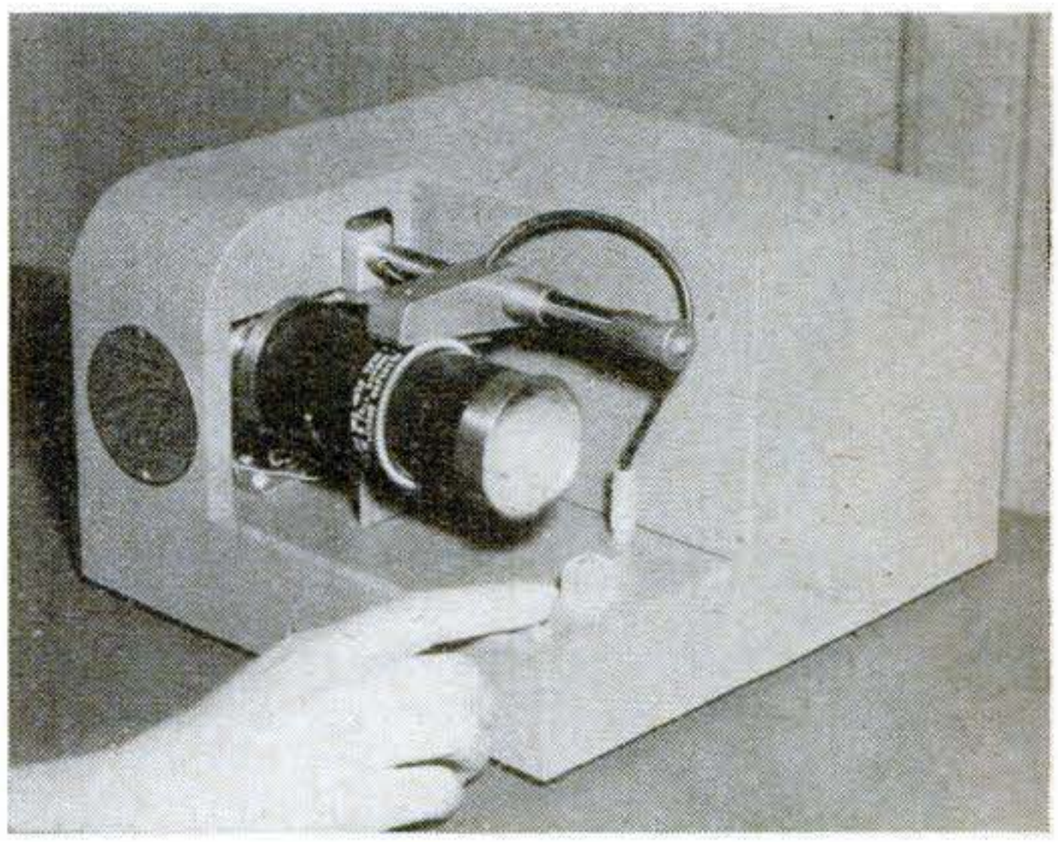
Light Scaffold Folds Up

THIS 13-foot aluminum-alloy scaffold weighs less than the man standing on it. Locked together without bolts from 52- to 64-lb. sections that fold flat for carrying, the structure can be rolled or anchored. Adding more sections permits quick assembly of towers up to 40 feet. Up-Right Scaffolds, of Berkeley, Calif., makes the units.



Meter Analyzes Colors

THIS is not a record player, but a new photometer that can measure 1/100,000,000 of the light from an auto headlamp. Its eye, a recently developed electron-multiplier phototube, also detects color differences too small to see. Designed for Ansco film research, the device may also be used to match colors in fabrics, paints, and dyes.



Box Delivers Telegrams

WESTERN UNION'S new Desk-Fax Ⓣ, above, puts telegraph service at your finger tips. A message, written on a waxed blank, is wrapped around the cylinder. As this turns, a stylus sends a series of electrical impulses whenever the writing breaks the wax. These cause an identical machine to write the message at the receving end.

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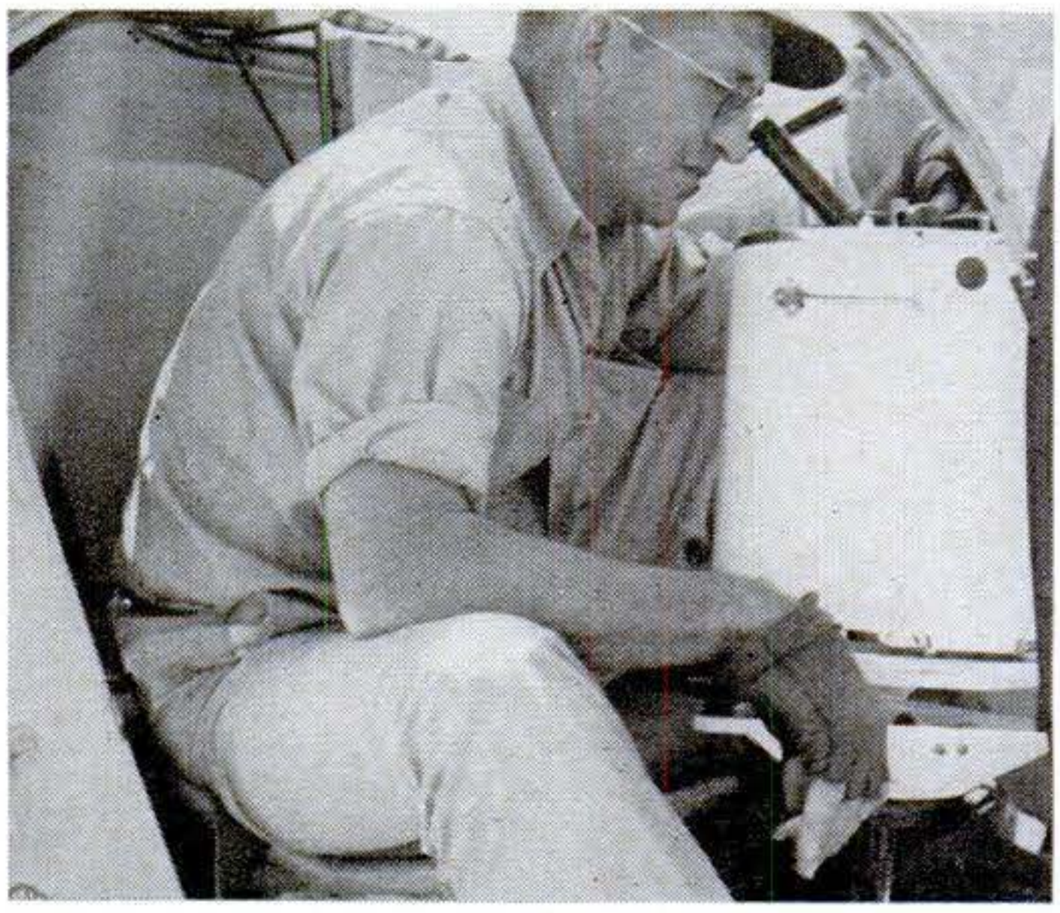
'Copter Makes Good As Oil Detective

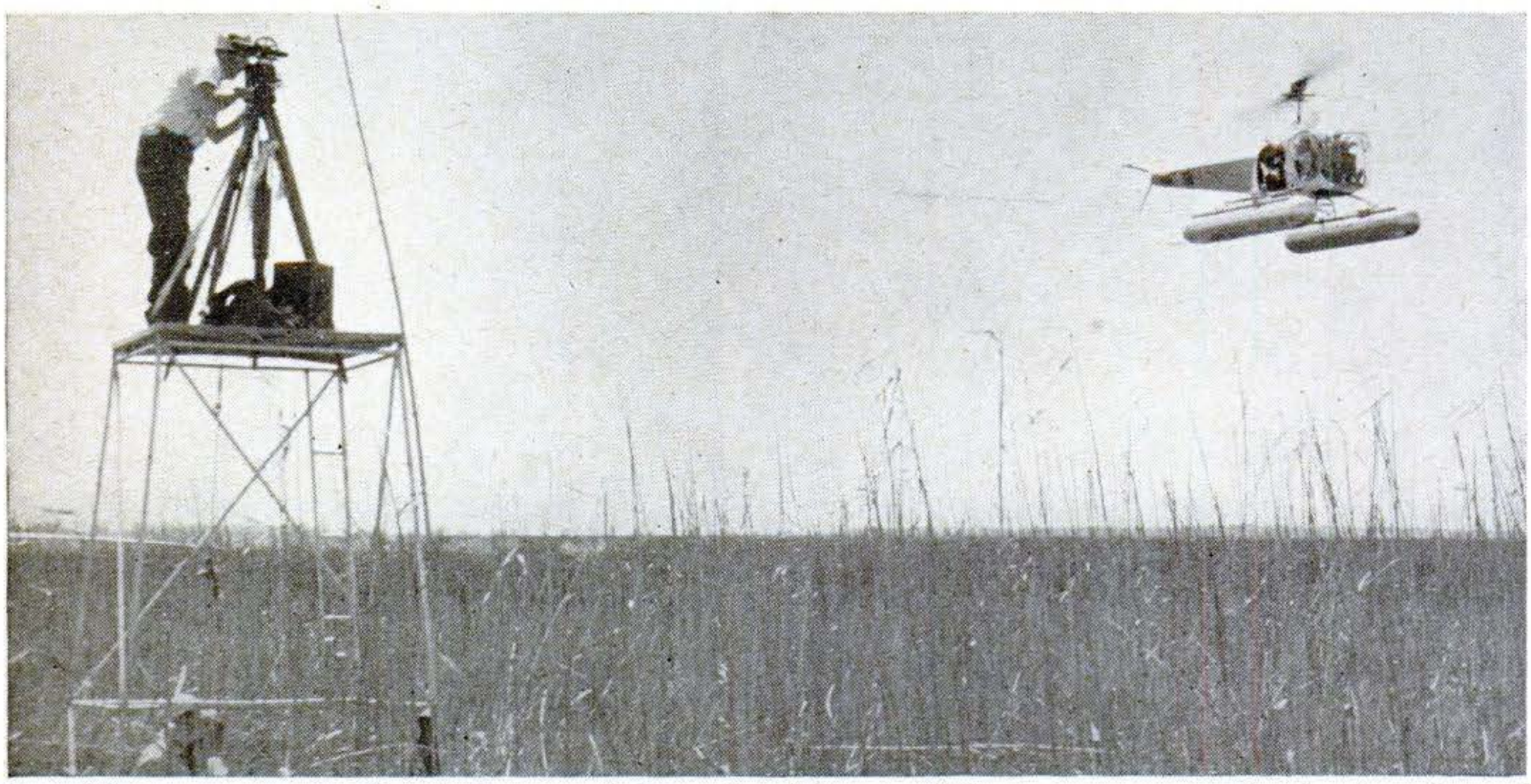
Pontoon-shod, this Bell helicopter explores deep into Louisiana swamp country for possible oil deposits. Tripod extending below the fuselage carries an oil-sleuthing gravity meter.

THERE'S oil in them thar swamps of southern Louisiana, claimed experts of the Shell Oil Company. The problem was to get in the equipment to set up gravity meters, sensitive to less than 1/10,000,000 of the total power of gravity, that give clues to areas for new, much-needed oil reserves.

Boats and marsh buggies can do the job, but they are too slow in view of currently increasing oil demands. Then the wingless aerial approach, the helicopter, entered the picture. As a result, surveys that had taken 180 days by the overland method were completed in 60 days. With the strong down draft of its rotors flattening reeds higher than a man's head, the 'copter lands, and the tripod is lowered into the earth. Freed of contact with the plane, it becomes the sole support of the gravity meter.



After landing, a geophysicist, seated in the helicopter, takes a gravity-meter observation. Minute variations from the normal pull of gravity may indicate new sources of oil reserves.



Portable towers are also helicopter-delivered into the **inaccessible reed jungles of** the bayou. They enable surveyors to fix the location of possible sites by triangulation with a transit.

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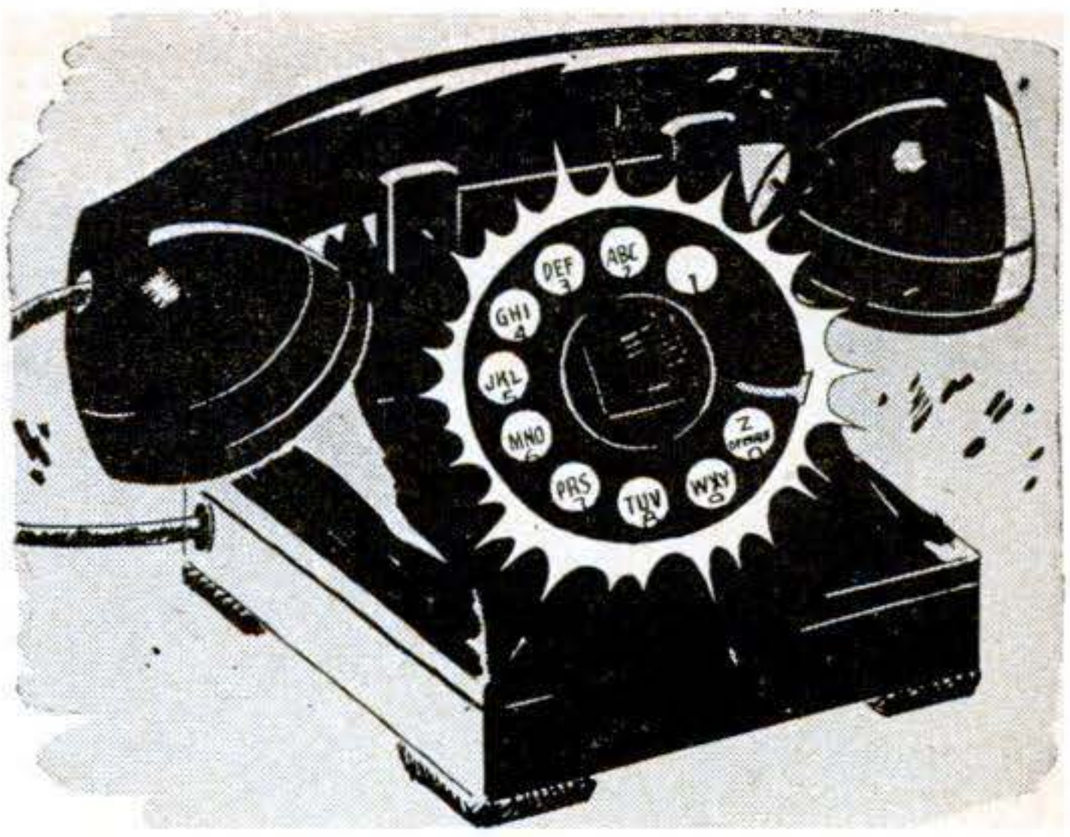
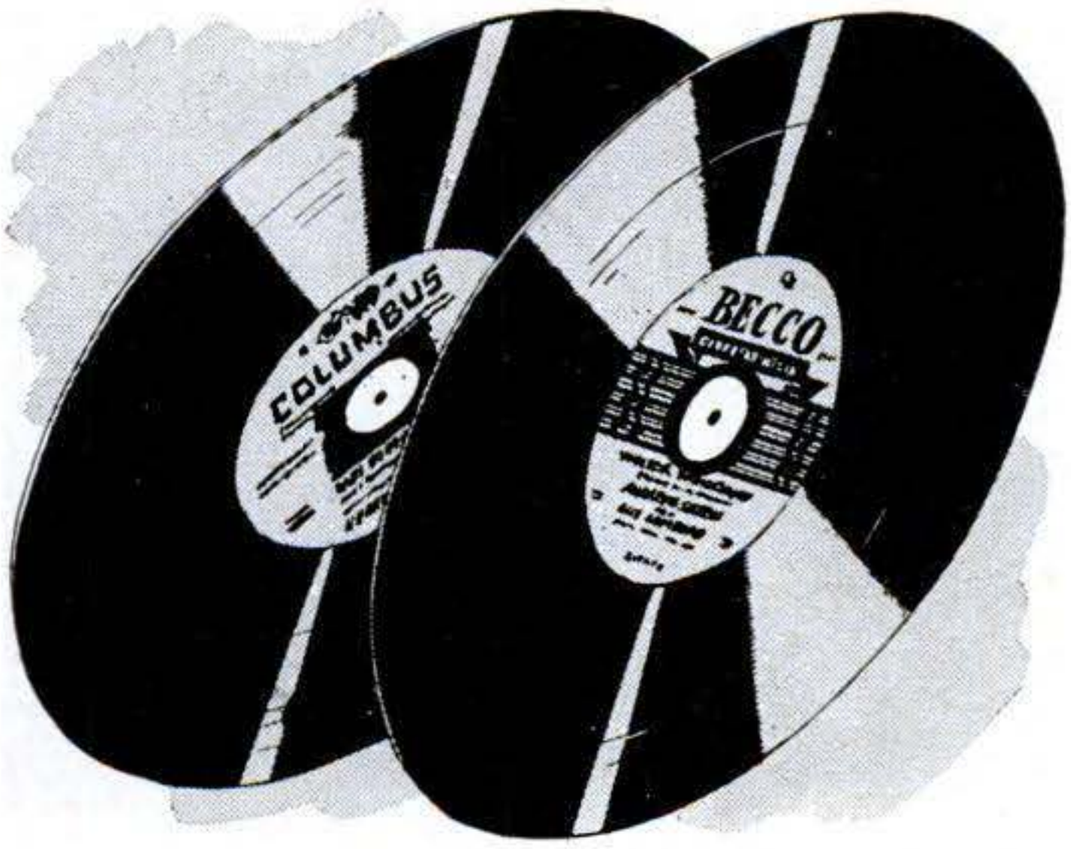
I'd like to see them make . . .



Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.

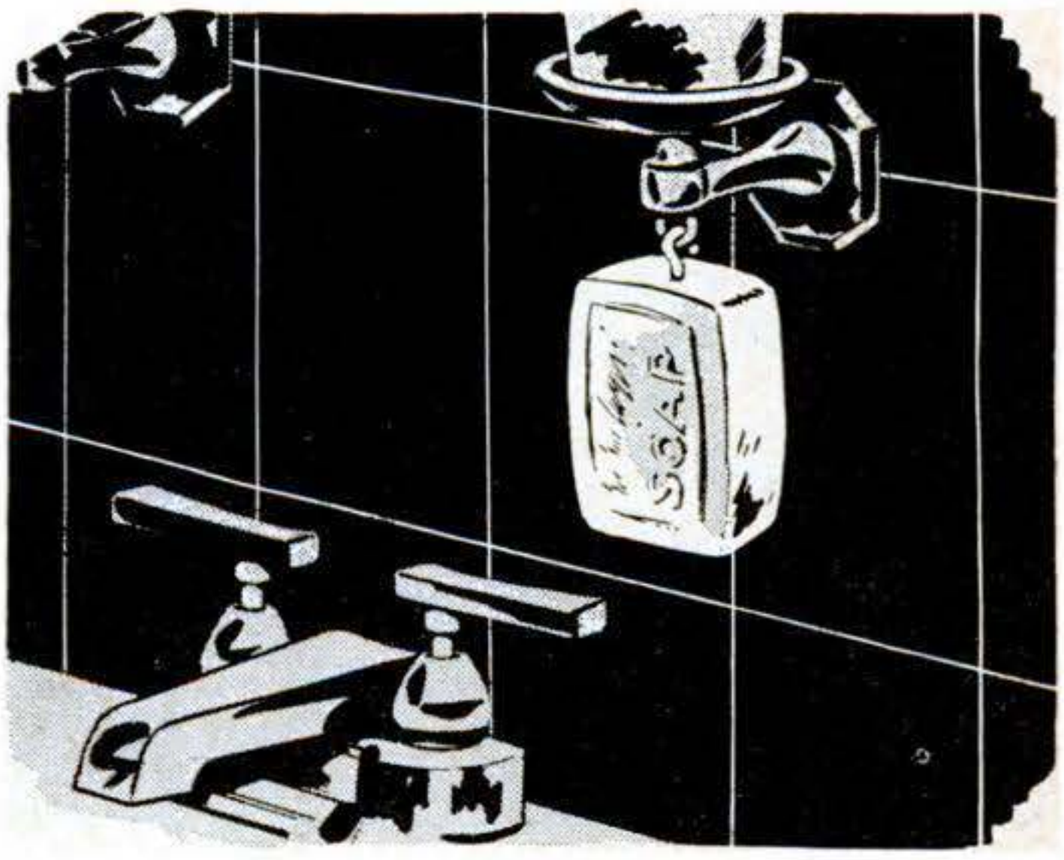
Luminous Dials. I was caught in a power failure—no matches, either—and I had a vital call to make. Luminous characters on phone dials certainly would help out a lot in like situations.—*Billy Keaton, Villa Rica, Ga.*



Wearproof Pivot Holes. Metal linings in the pivot holes of recordings would prevent chipping and enlargement of the holes and the consequent distortion such damage creates.—*Fred Gentile, Ridgebury, N. Y.*

Steering-Wheel Speedometer. Now that most new cars have a horn ring, why not place the speedometer in the easy-to-see top of the steering column? It would keep eyes front.—*Billy Zies, Rochelle, Ill.*

Nice-Smelling Flux. Why not a pleasant-smelling flux for electric welding rods? The present stuff is awful, especially if you're working in cramped quarters. Maybe the odor could be neutralized.—*Neal J. McDonald, Buffalo, N. Y.*



Hang-Up Soap. Soap left standing usually comes up with a gooey, messy side. An inexpensive plastic hook imbedded in the bar would let you hang it up to drain evenly.—*Anthony Pozzuoli, Manhattan, N. Y.*

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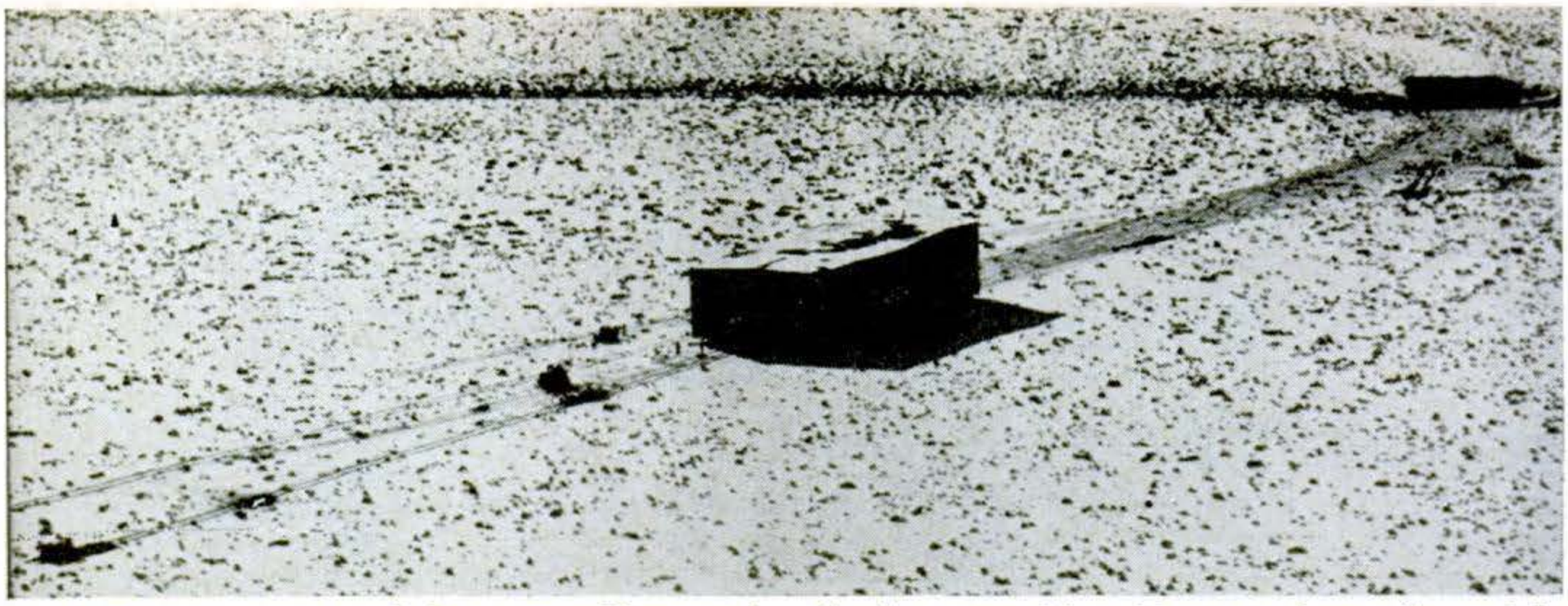
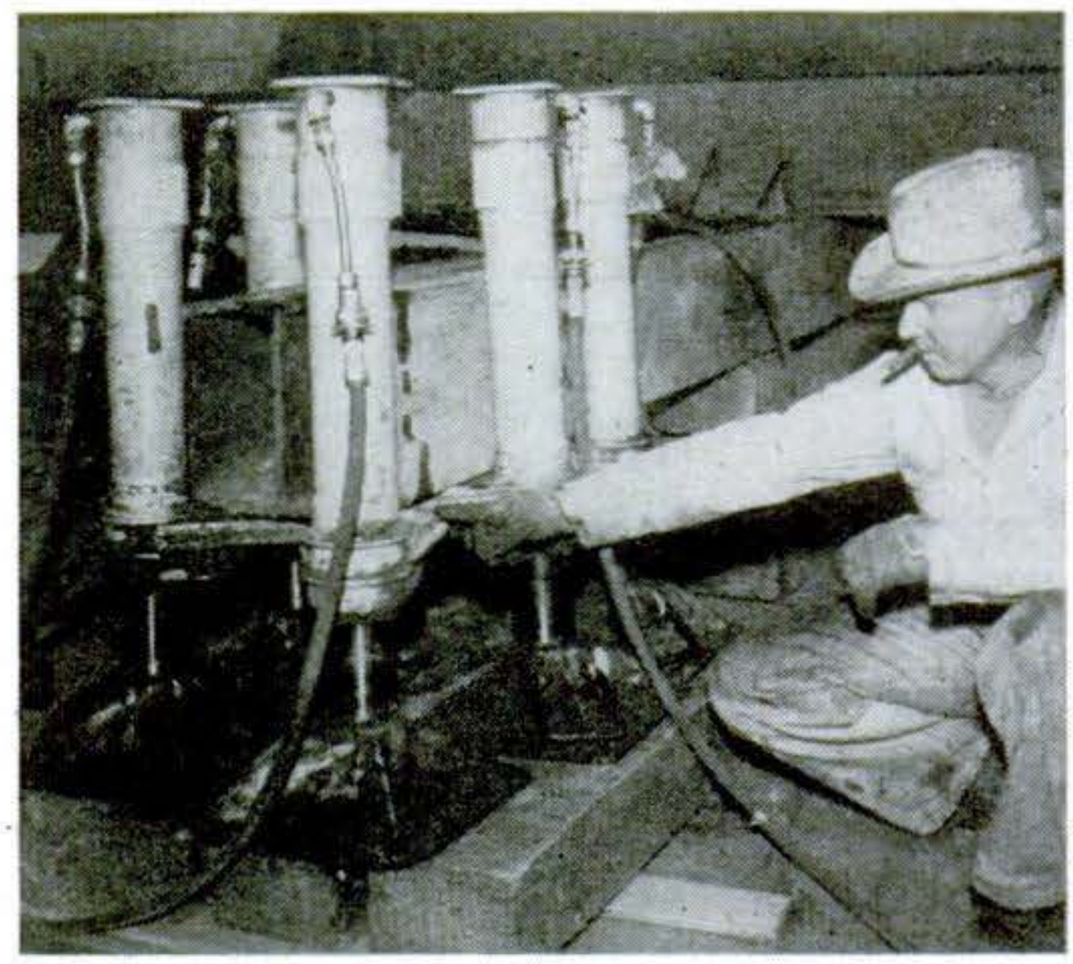


Its 350 tons supported by 146 rubber-tired wheels, former airbase gymnasium makes tracks slowly across New Mexican desert from right background. The trucks moving it are inside.

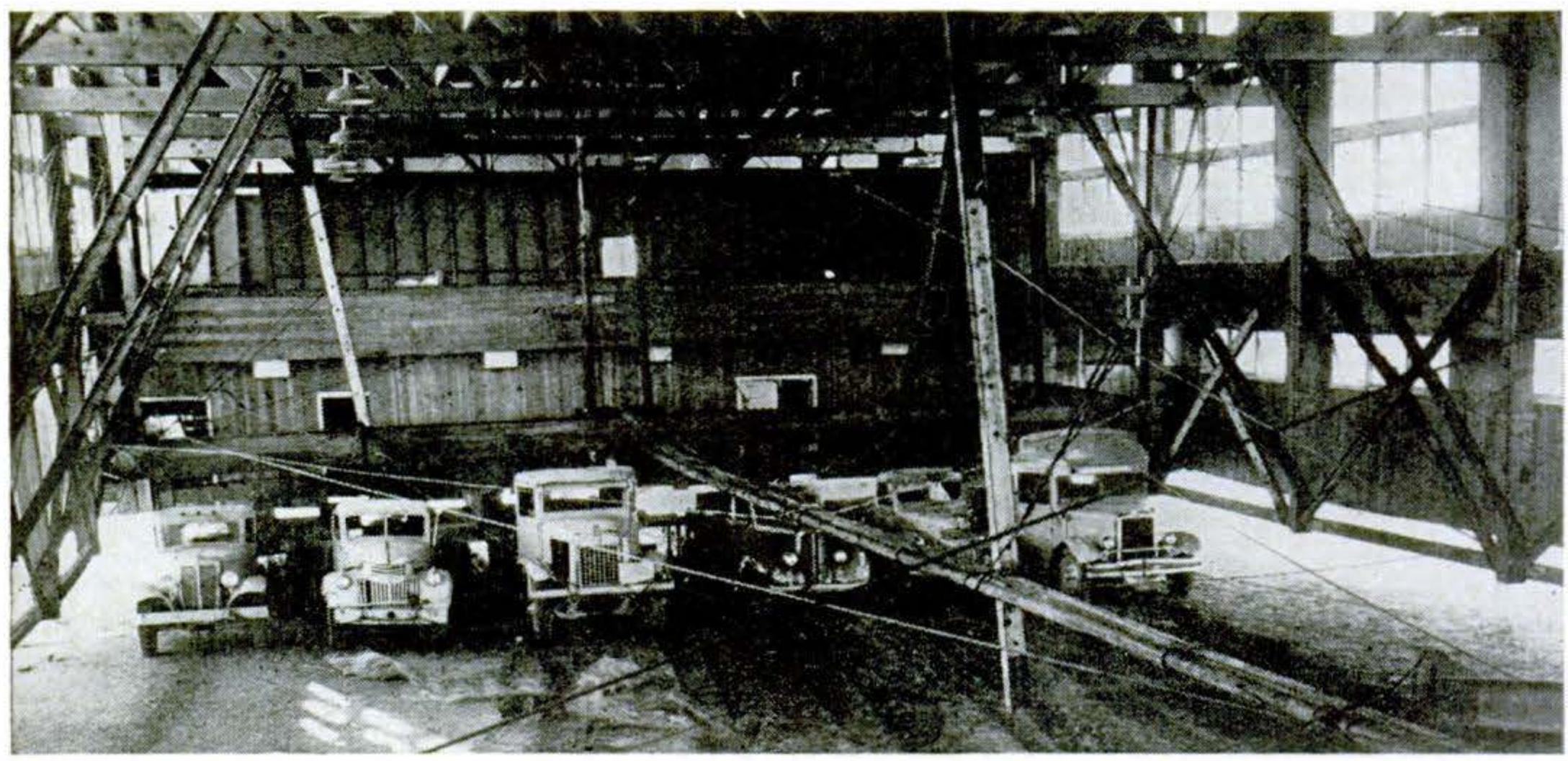
350-Ton Building Moved 70 Miles

NEAR Ft. Sumner, N. M., the Army had a fine wartime gymnasium and nobody to use it. At Portales, 70 miles away, Eastern New Mexico College needed just such a building for workshops. Problem: how to move the frame structure—160 ft. long, 80 ft. wide, 30 ft. high—across a desert that didn't even have a road most of the way.

These pictures show how 17 men did it in 68 days. Improvised hydraulic jacks hoisted the gym, in one piece, aboard nine trucks and 22 four-wheeled dollies made with wheels from scrapped bombers. The trucks, geared down to a snail's pace, then pulled together as directed by loudspeaker.



Hydraulic jacks to lift the building smoothly from its foundation and then lower it onto trucks and dollies were built from nose-wheel shock absorbers salvaged from wartime bombers.



Six of nine trucks used to move gym are shown carrying rear end. Two tractors helped on hard pulls. Thirty tons of steel beams kept building from cracking even when it crossed a railroad.

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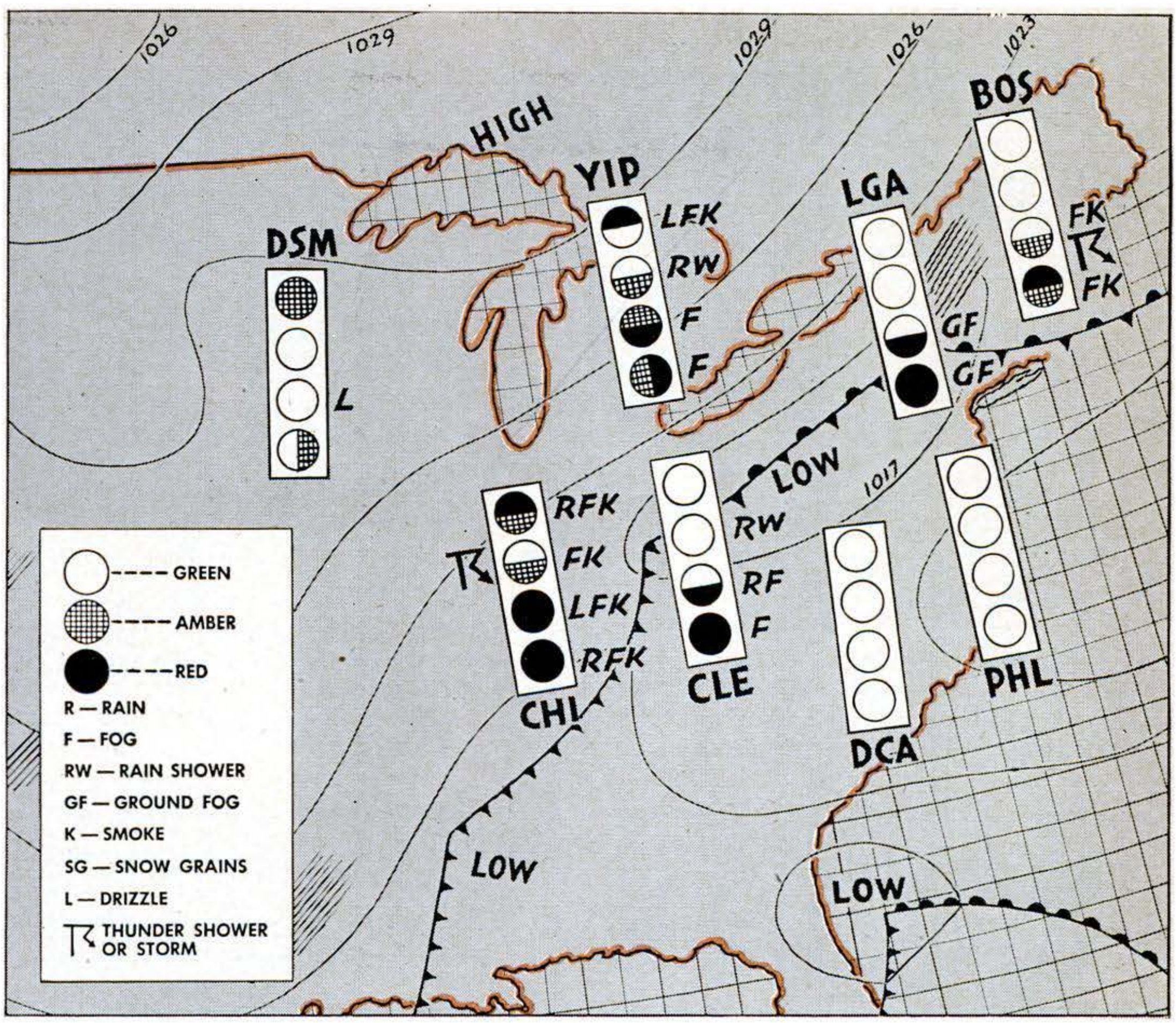

Map Tells Weather at a Glance

ANYONE who has puzzled over weather maps in the daily newspapers will appreciate the simplicity of the one shown above. Devised by United Air Lines, this weather-at-a-glance map gives non-flying operational personnel a quick picture of flying conditions the country over for a 24-hour period. Its symbols are based on a traffic-light color system. Each circle in a block of four represents six hours, with the top one beginning at 6 a.m.

Green Circles: routine weather, with no interruption of operations (ceiling above 1,000 ft., and visibility two miles or better); *Amber Circles:* interruptions may be expected (ceiling between 1,000 and 500 ft., visibility from one to two miles); *Red Circles:* socked in (ceiling under 500 ft., visibility less than one mile). When a circle is split horizontally, the weather has changed during the six-hour period it covers; when the split is vertical, it indicates that a change is expected or has just occurred.

Code letters beside the circles give further details, and are explained in the box at the lower left-hand corner of the map.

Weather information for the map is collected and distributed by United's six master meteorological stations located in Seattle, San Francisco, Denver, Lincoln, Chicago, and New York. Code names for cities shown on this section of the map are: Boston (BOS), New York (LGA), Philadelphia (PHL), Washington (DCA), Cleveland (CLE), Ypsilanti (YIP), Chicago (CHI), and Des Moines (DSM). END

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Jump into the Jeepster

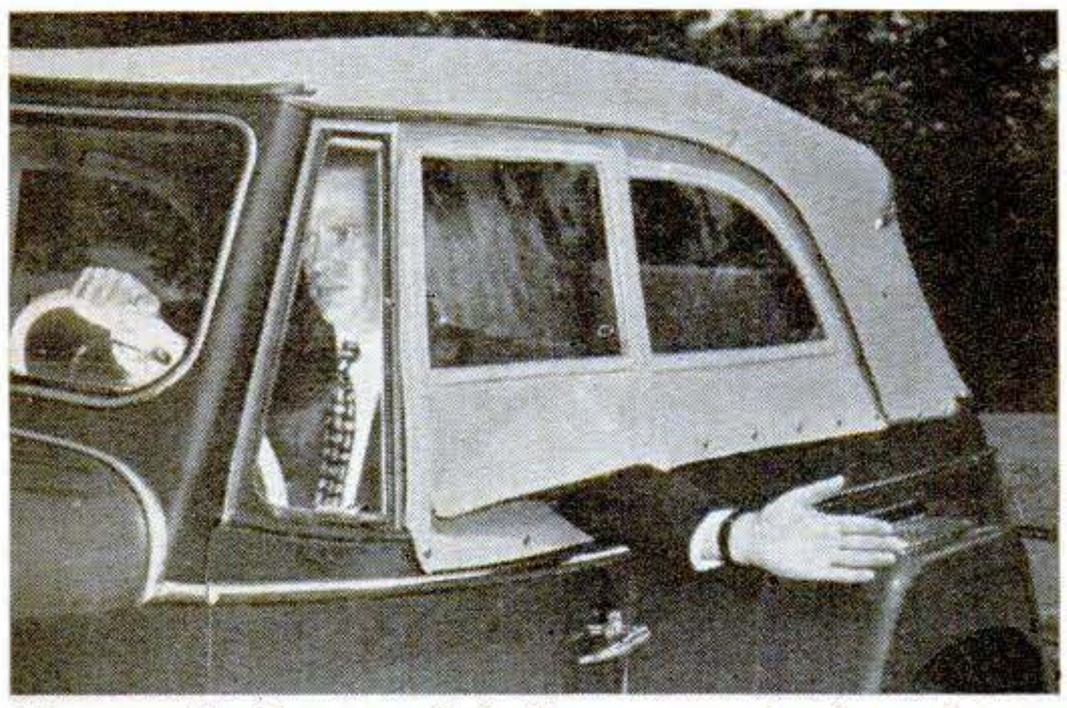
Front end has a chrome bumper and stainless-steel radiator plate for glamor, but retains distinctive Jeep shape.

THE war-time Jeep now has a glamorous descendant—a sporty-looking convertible called the Jeepster. You have a choice of two colors, yellow with a black top or fire-wagon red with gray top.

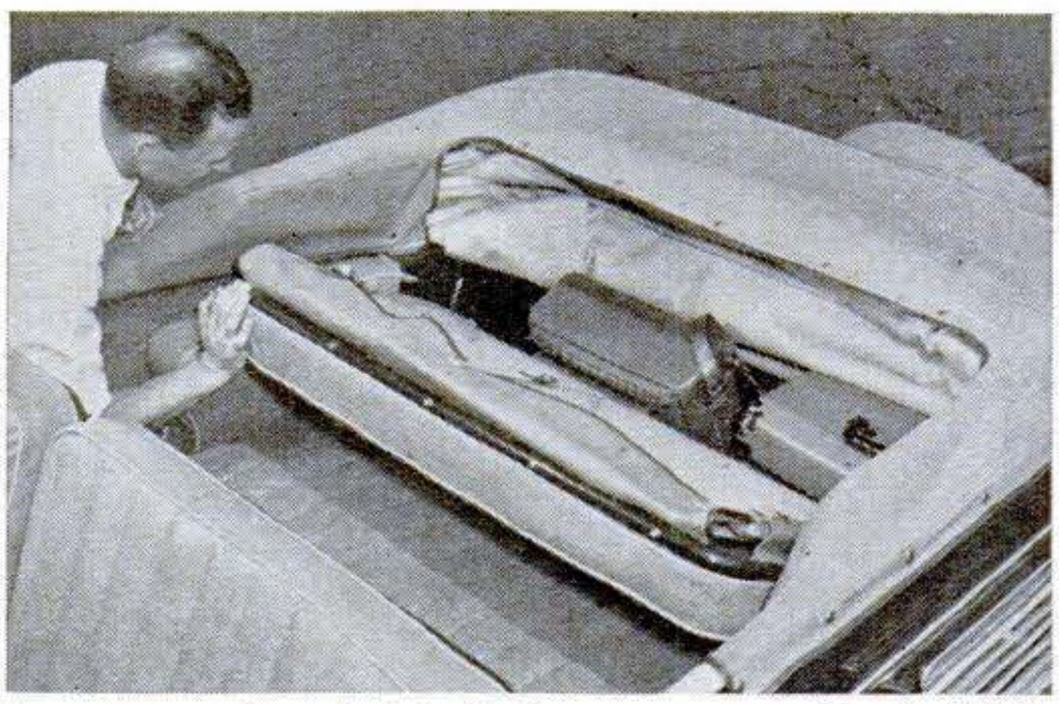
First announced some months ago (PS, Jan. '48, p. 126), the Jeepster now has been made a main production unit of Willys-Overland. The delivery price is less than $2,000.

Powered by the standard four-cylinder Jeep engine, it has an average gasoline consumption of 29 miles per gallon at 35 m.p.h. Drive is only to the rear wheels.

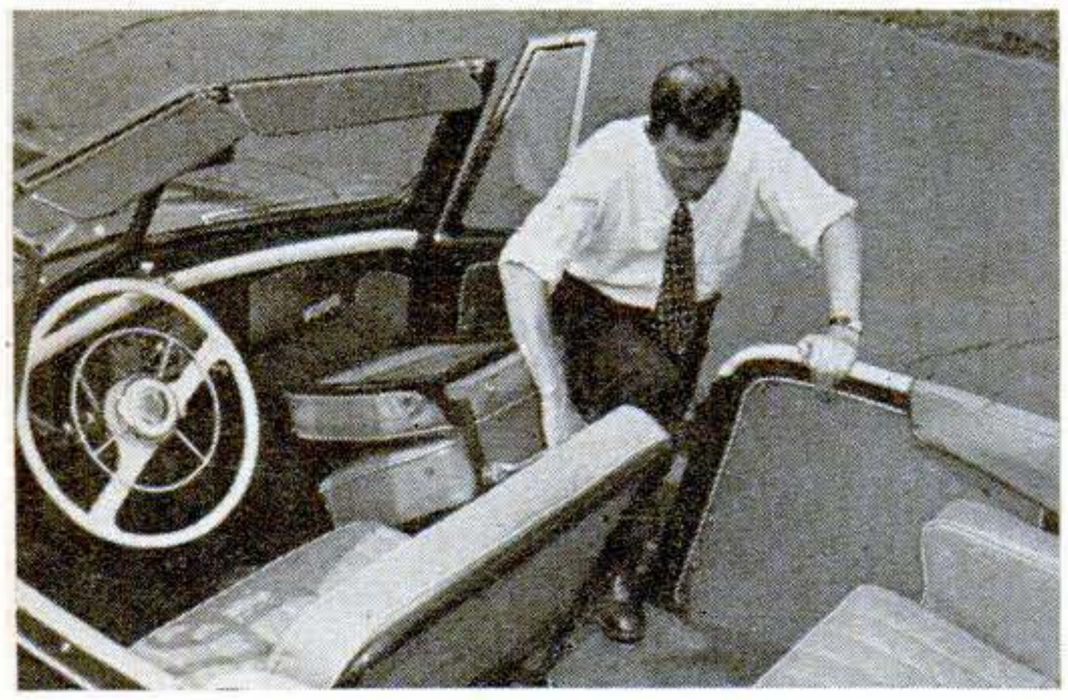
Built on a 104-inch wheelbase, the Jeepster weighs 2,500 pounds. Overall length is 174 inches, width 69 inches. With the top up, it stands 62 inches high. The top is a four-bow type that is easily raised or lowered by one person. Low-pressure tires increase riding comfort.



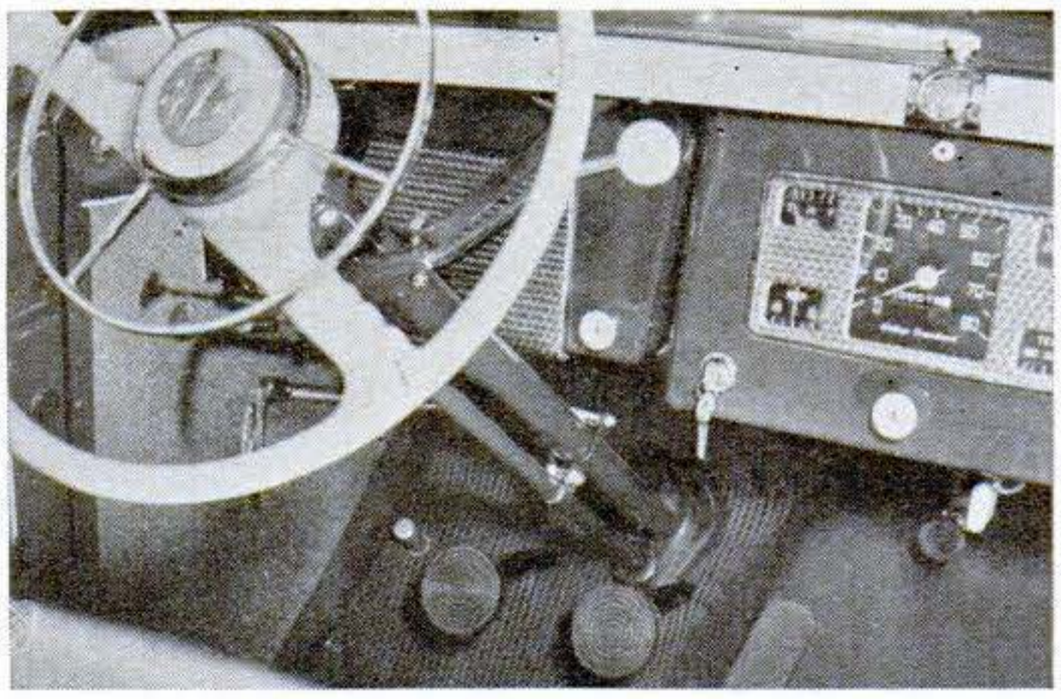
Zippered flap in left-door curtain lets driver signal quickly. Curtains, stretched on metal frames, can stay in place with top up or down. Note rear-seat step behind driver's hand.



Luggage goes behind the rear seat. Back folds forward for access to the compartment. The curtains can be stowed in the big pocket on the back of this seat. Spare is at the rear.



Those not so nimble can get into the rear past foldable portion of front seat. There's room for two on the driver's seat. If necessary, three can squeeze into the Jeepster's back seat.



Overdrive lever and hand brake are seen at the left of steering wheel. Overdrive is standard equipment on the Jeepster. The car can do better than 70 m.p.h. with its 63-hp. engine.

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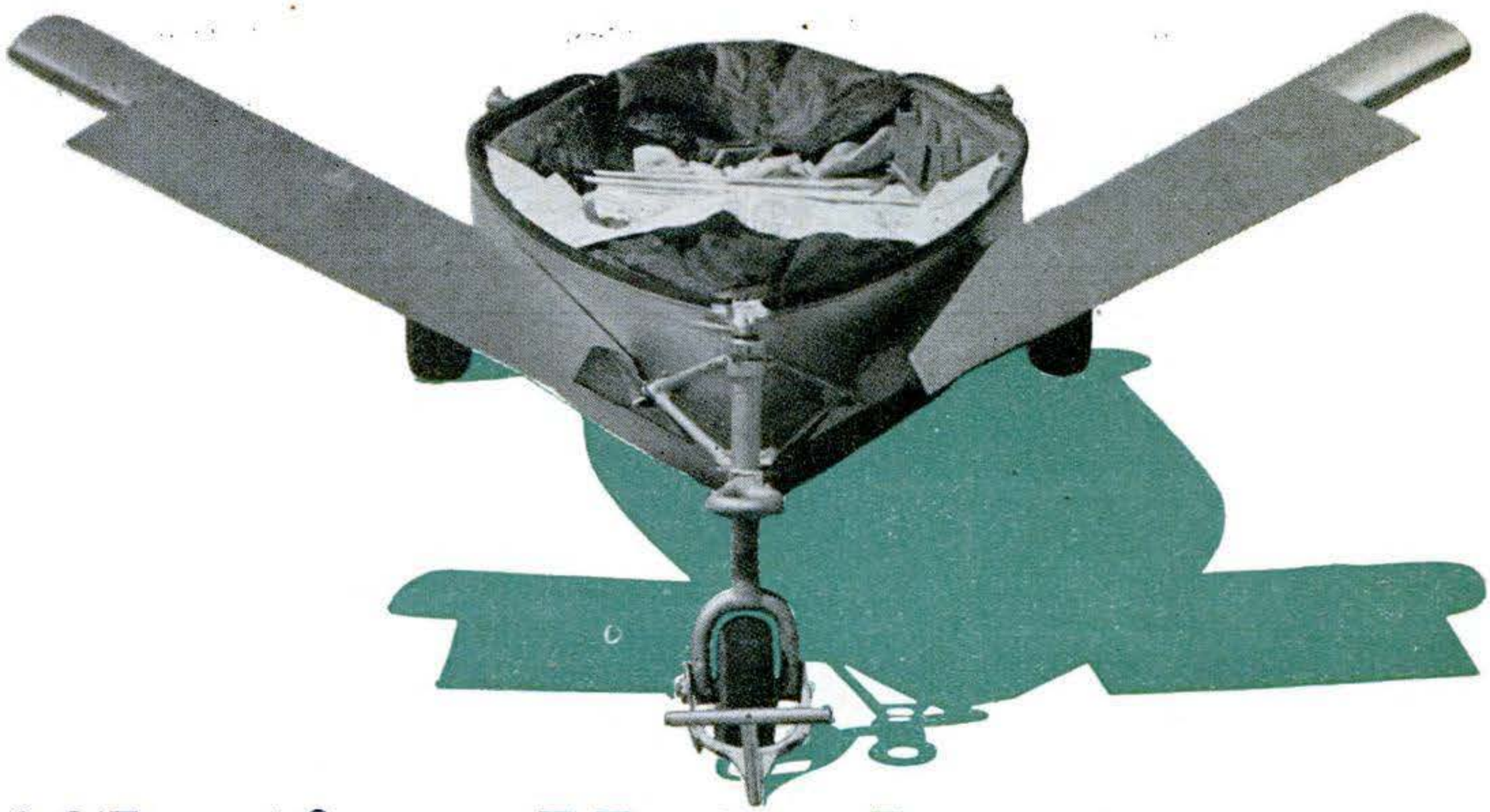

'Chuting Motorboat for Sea Rescues

By Devon Francis

PS photos by W. W. Morris

B-29 delivers 29-foot craft that can carry 15 survivors of ditched plane 600 miles at 8 knots in heavy sea.

FOR nearly two years U. S. Air Forces researchers have been working on a way to boost the life insurance of long-range bomber crews that are forced to ditch their planes in ocean waters. Last month at their whopping Wright Field laboratories at Dayton, O., they demonstrated that they had it—a 15-man metal motorboat that can be dropped by parachute. This flying lifeboat can weather 18-foot waves and voyage for almost 600 miles under its own power.

Assuming that use of the new craft will be based on experience gleaned from rescue work in World War II, this is what will happen when an airplane goes down at sea:

A B-29 or B-50 will race to the area where the unlucky crew is tossing around in rafts. Snugged under the big rescue plane's belly will be the new flying motorboat. The mother plane will drop a smoke float to determine the direction and velocity of the wind. Then it will square away for an upwind run on the men below. Peering through a sight at an altitude of only 800 feet, the bombardier will flick a switch when he is over the rafts. That will release the motorboat from the single bomb shackle holding it to the belly of the bomber.

Guided straight and true in the line of flight by a pair of fins, much as an airplane is stabilized in flight, the boat will curve away from the mother ship for a couple of seconds. At that instant a lanyard attached to the plane will yank out a pilot parachute, and then the main 'chute, 100 feet in diameter, will begin to fill. This 200-pound 'chute, the biggest ever put into quantity production, will lower the boat at 18 to 22 feet a second.

Another lanyard will open two carbon-

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1 B-29, flying 185 m.p.h. at 800 ft., drops new USAF rescue boat attached to huge parachute.

2

3

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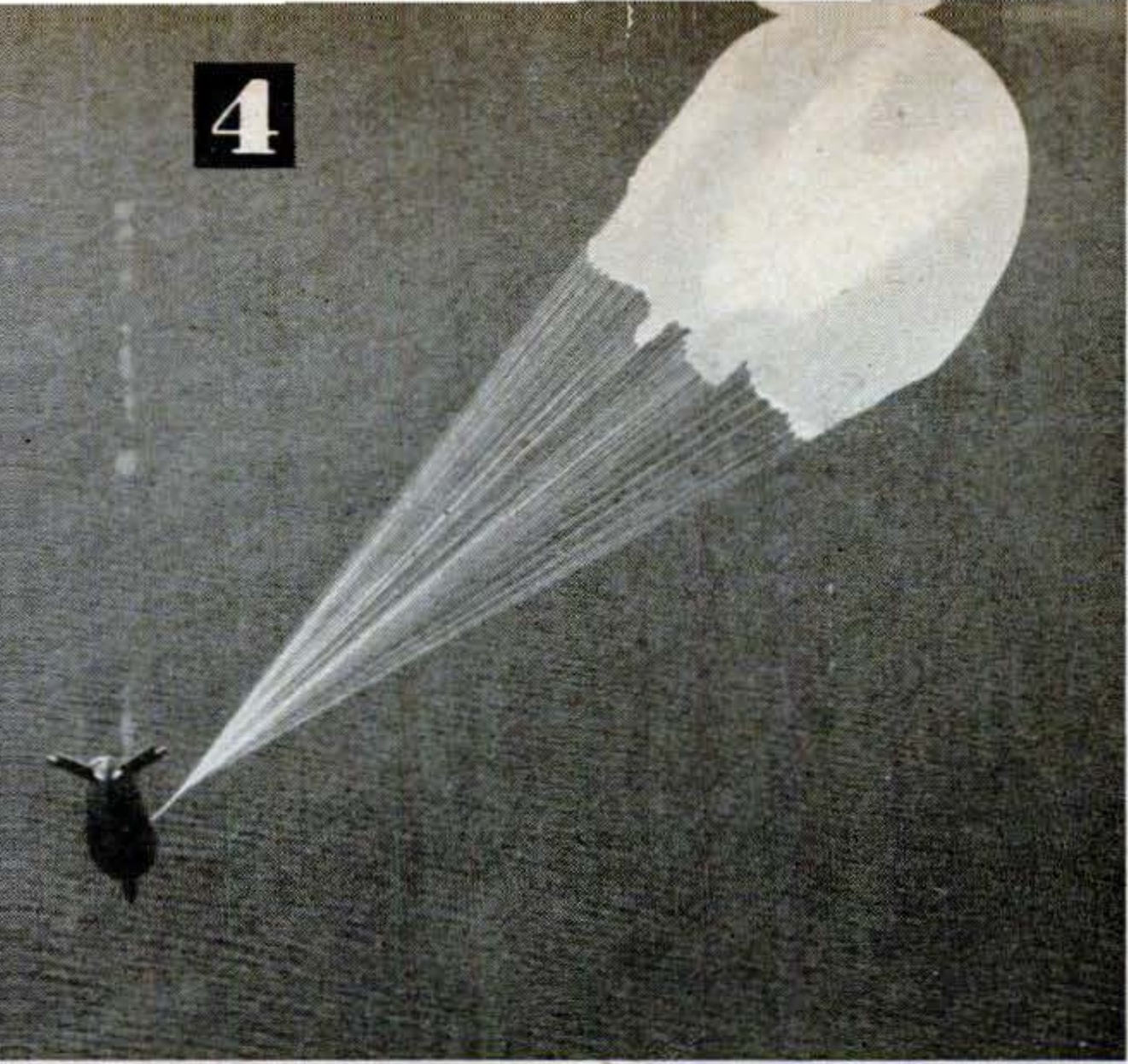
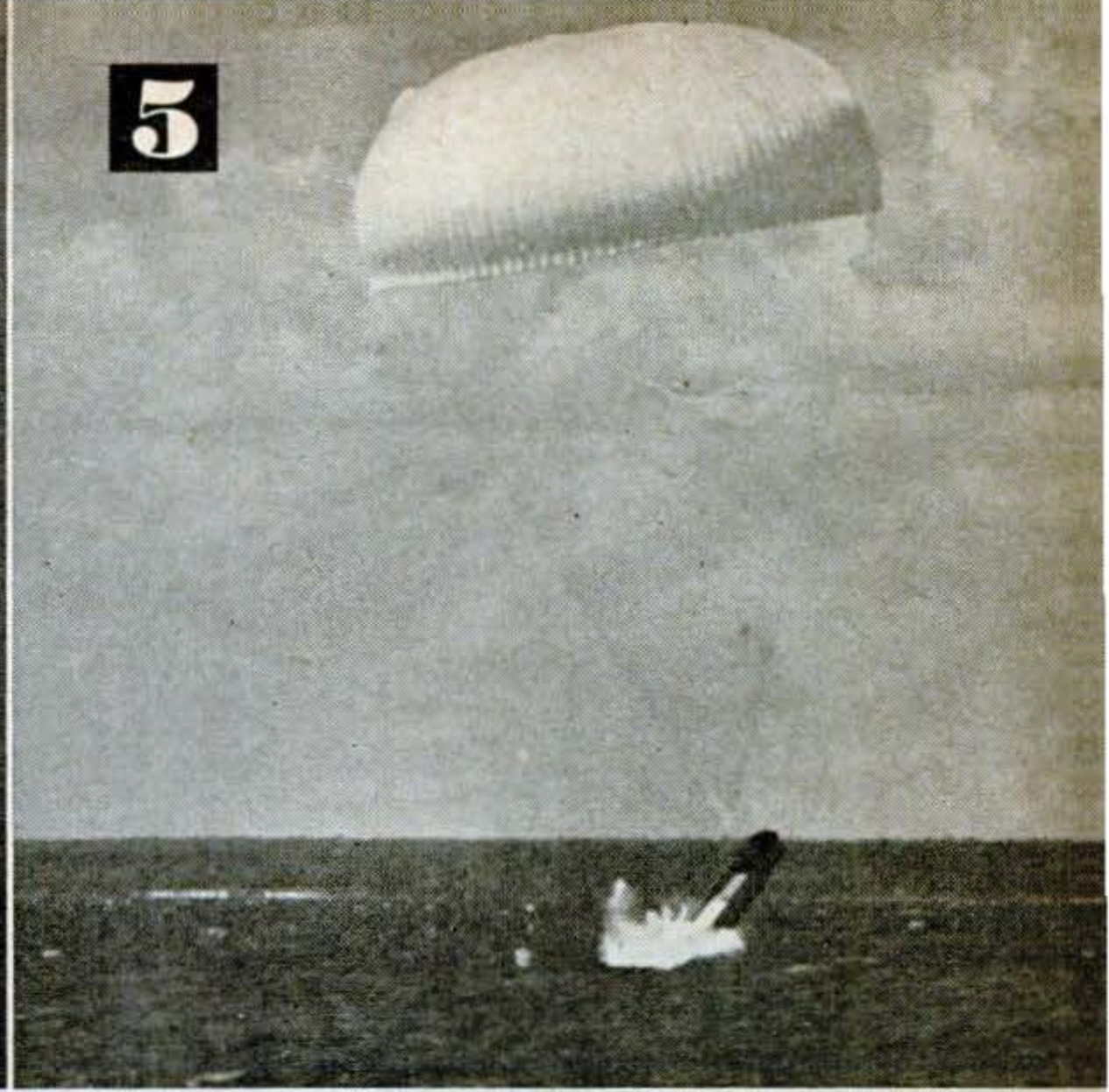
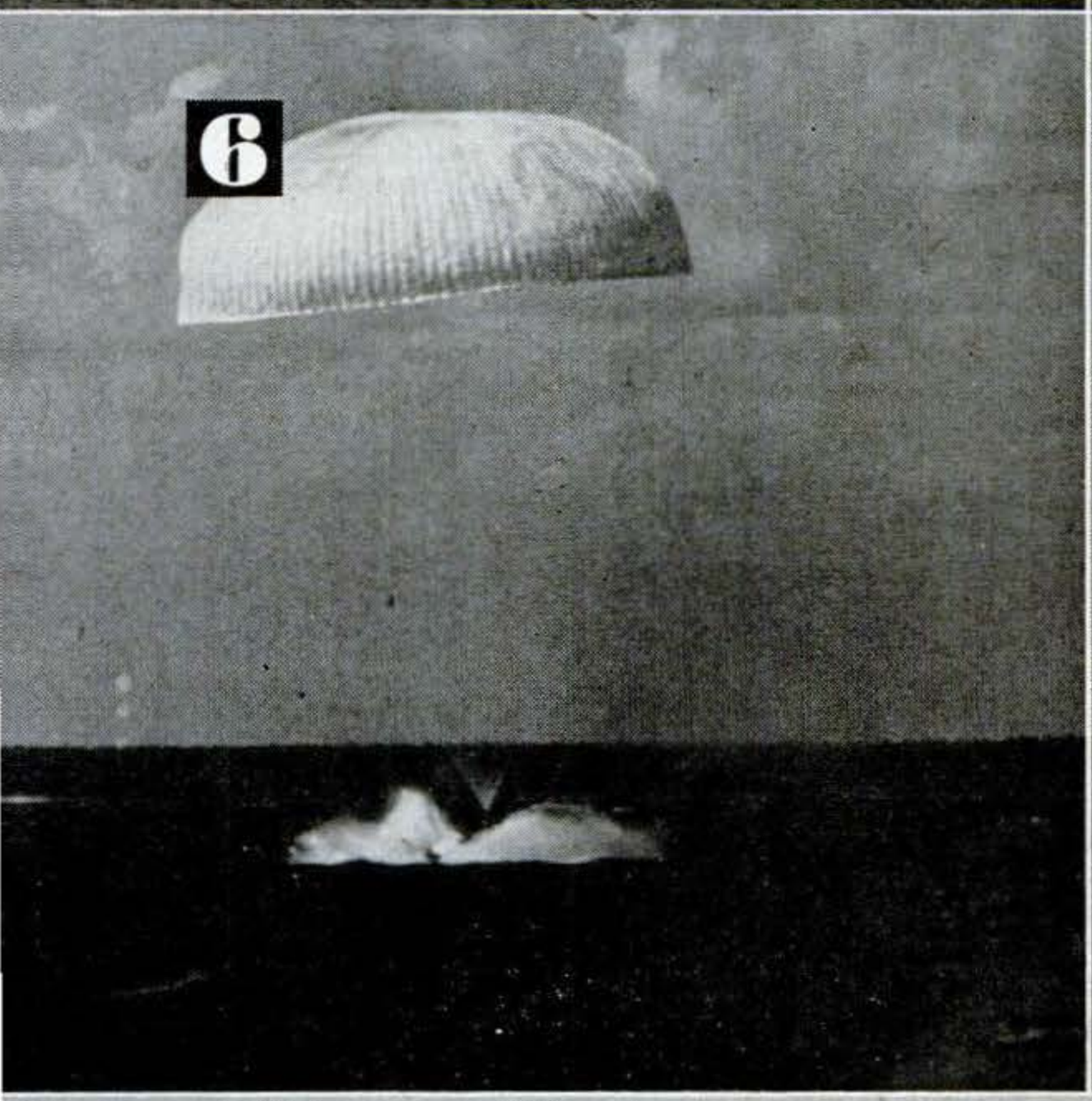
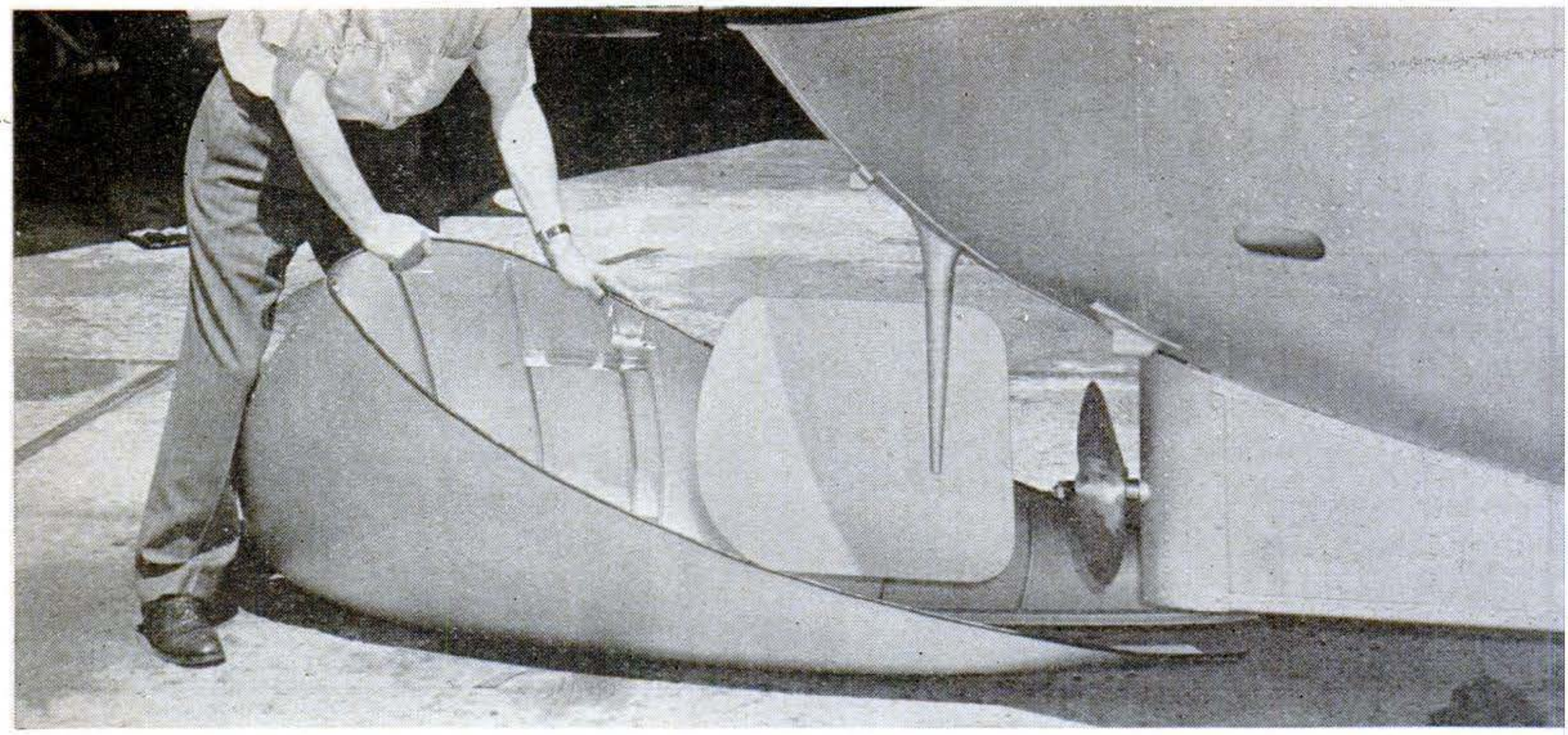






8 Righted by balloons blown up in bow and stern during drop, boat chugs off under own power.

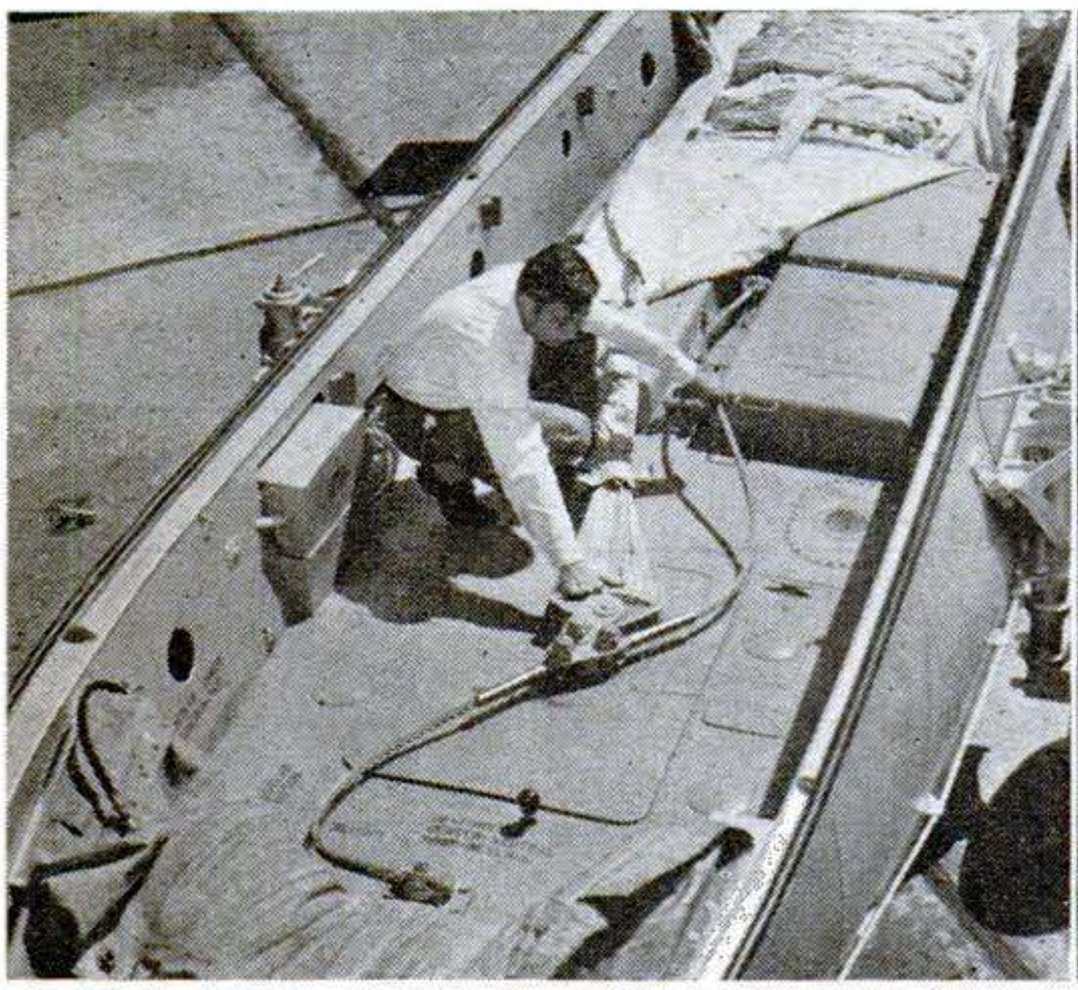


Metal guard over rudder and propeller streamlines new USAF rescue boat in flight, keeps parachute from fouling when craft is dropped, and prevents damage when it hits the water.

dioxide bottles anchored to the floor of the motorboat. These will have inflated two rubberized self-righting chambers on the bow and stern by the time the boat hits the water. Hence, if the boat lands upside down, it will right itself instantly.

The 'chute will now collapse, and the boat will drift downwind toward the stranded airmen while they are paddling toward it. When they reach it, they will yank a rope at its waist. This will release a pair of boarding ladders, and the men will step into a vessel far superior to their rafts. In this big lifeboat, they will be able to make almost 8 knots with its 18-hp. engine. Its interior can be kept as dry as a hearth by stretching a nylon canopy over the three midship hoops and sealing it all around.

To the Air Force, this 20th century version of Captain Bligh's longboat is known as the A-3 droppable lifeboat. Whether war comes or not, it will be a boon to men tossing about on rafts after ocean crashes, whether in icy Arctic waters or torrid tropic seas. If war should come, the risks run by men making long flights over the top of the world (PS, Aug. '48, pp. 75-81) will be greatly reduced.



Steel cable from parachute is attached to boat just aft of horizontal center of gravity, so that bow will hit water first. Craft is 29 ft. 9 in. long and, as dropped, weighs 3,400 lb.

Single shackle clamps boat to bomber. Here, a plane crewman in the boat guides the hook to its anchorage amidship. Gunwale is cushioned with rubber to prevent chafing against plane.

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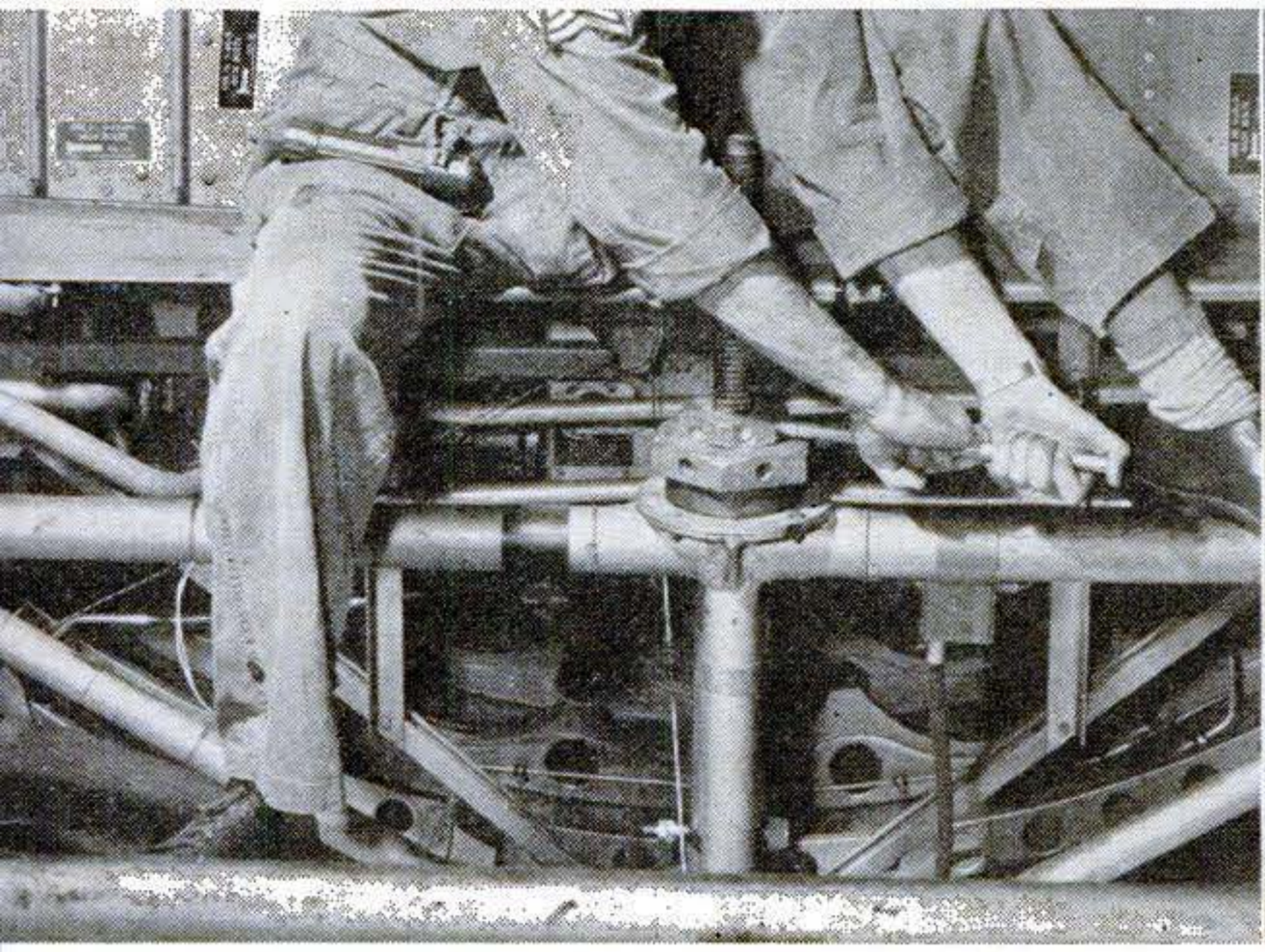
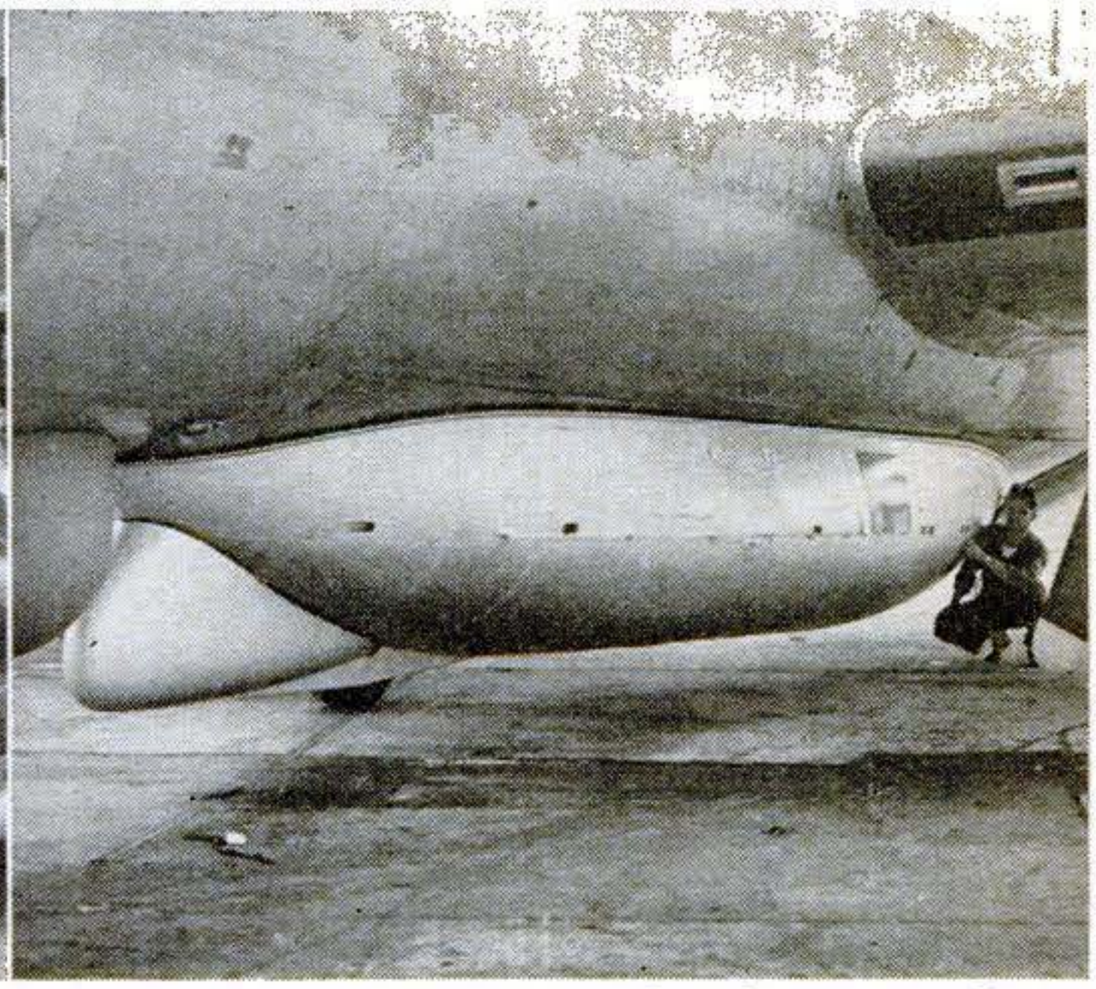
For loading under bomber, boat is rolled into place on tricycle beaching gear. Flight fins extending from the bow act as both horizontal and vertical stabilizers when it is released.

The A-3, contrived by Capt. F. C. Spinney, project officer, is produced in quantity by the Edo Aircraft Corp. at College Point, N. Y. It will be employed in wartime the way the A-1, which B-17s carried, was used in World War II. But it will be a lot more useful. The old A-1s, for example, were made of laminated wood. In the tropics, termites feasted on them. The boats carried only one-lung engines that could hardly maintain seaway in heavy weather. The three parachutes needed to drop them weighed two and a half times as much as the one 'chute that lowers the A-3. Any metalworker who can patch the skin of an airplane can mend the aluminum A-3.

And apparatus still to come will make the new lifeboat even more valuable. Radio controls will permit the A-3 to be operated from the air as soon as it hits the water. Five radio channels will be provided on a control panel in the mother aircraft. One will jettison a sheath that protects the propeller and rudder of the boat during flight and fins that keep it going straight in the air just after release. A second will start the engine. A third will move the throttle, and the fourth and fifth will steer the boat.



Jackscrew is tightened by a second crewman, in bomb bay, to draw the boat snugly against plane's fuselage. For release, shackle can be opened either pneumatically or mechanically.



Beaching gear removed, bomber is ready to take off with rescue boat under its belly. After boat is in the water, guard over rudder and propeller is jettisoned by pulling a lever.

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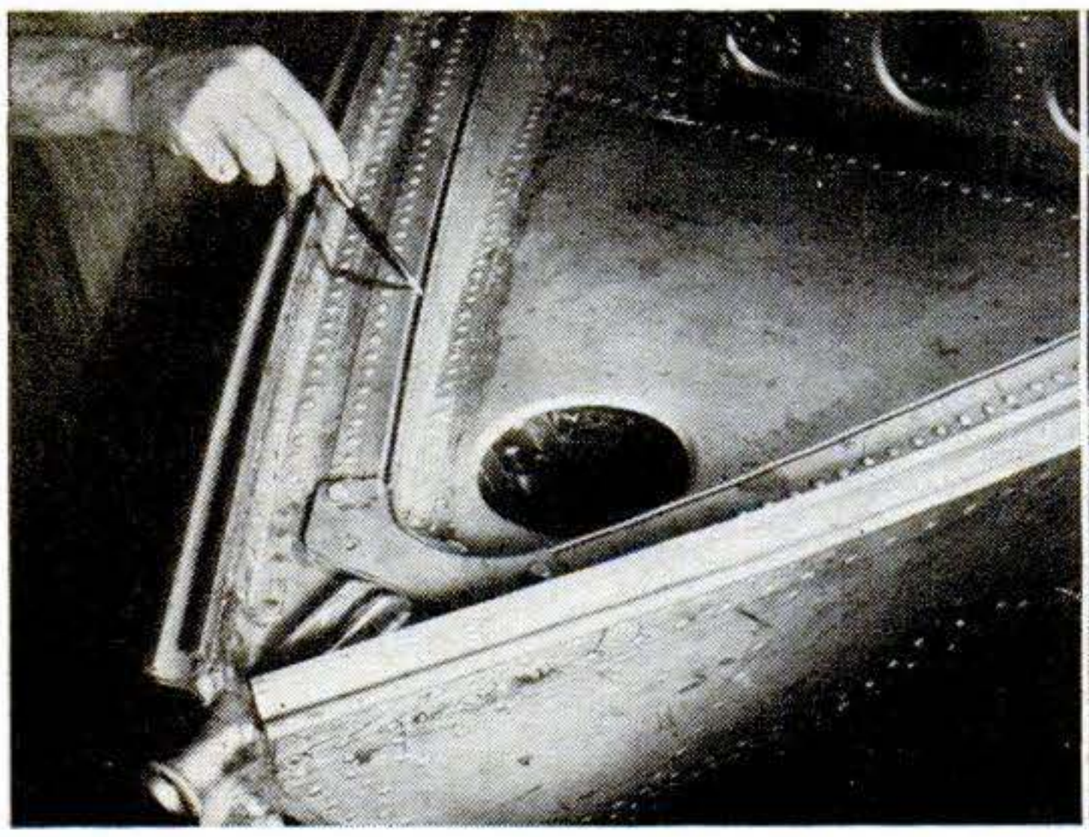
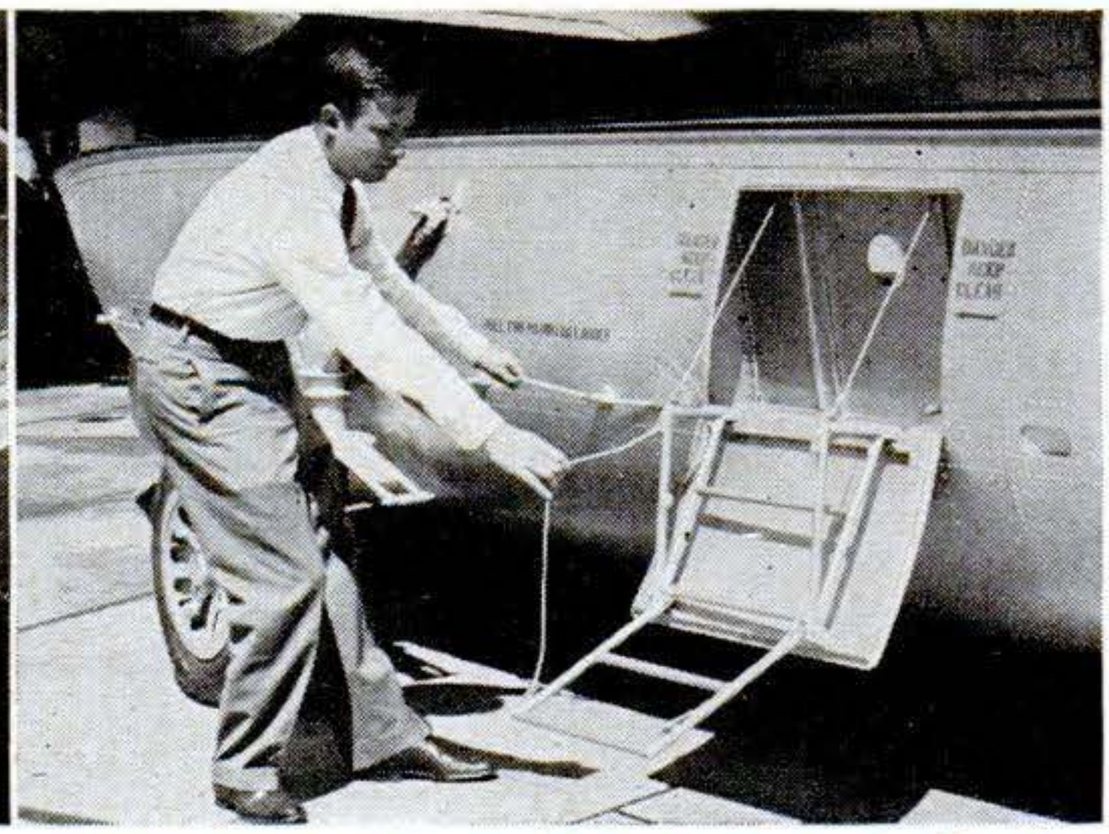
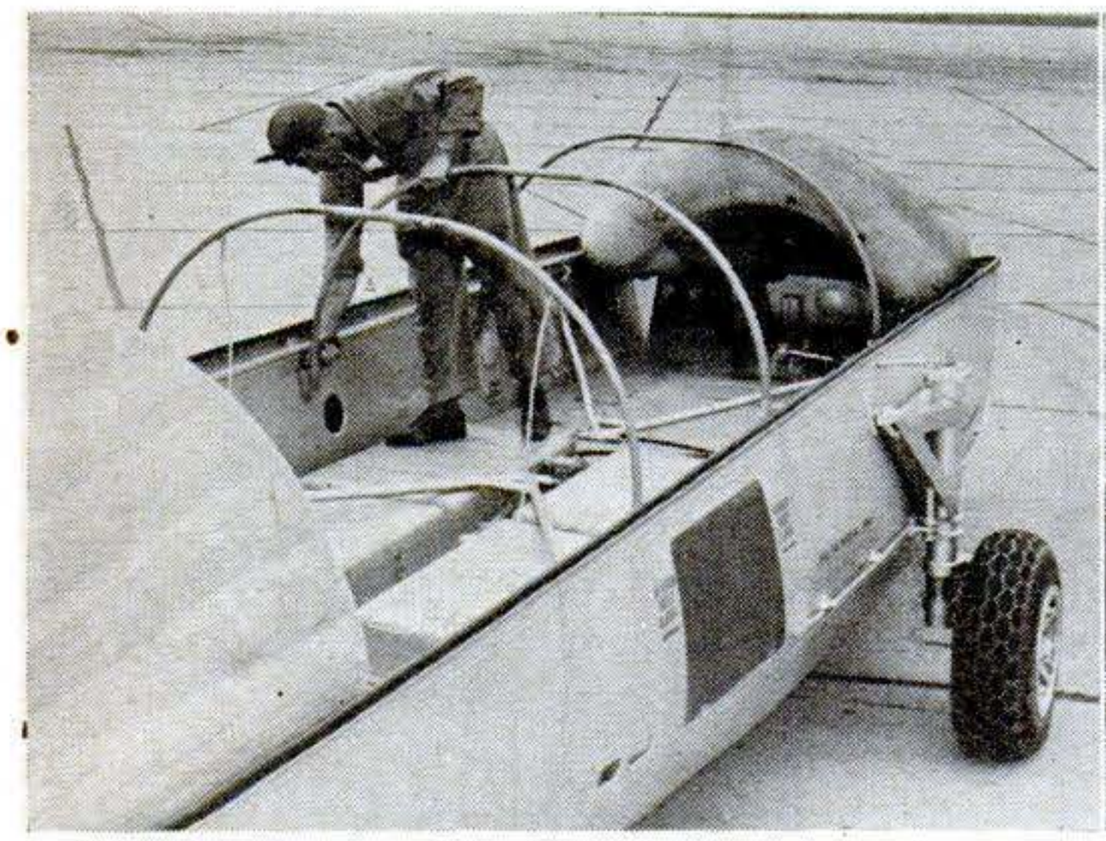


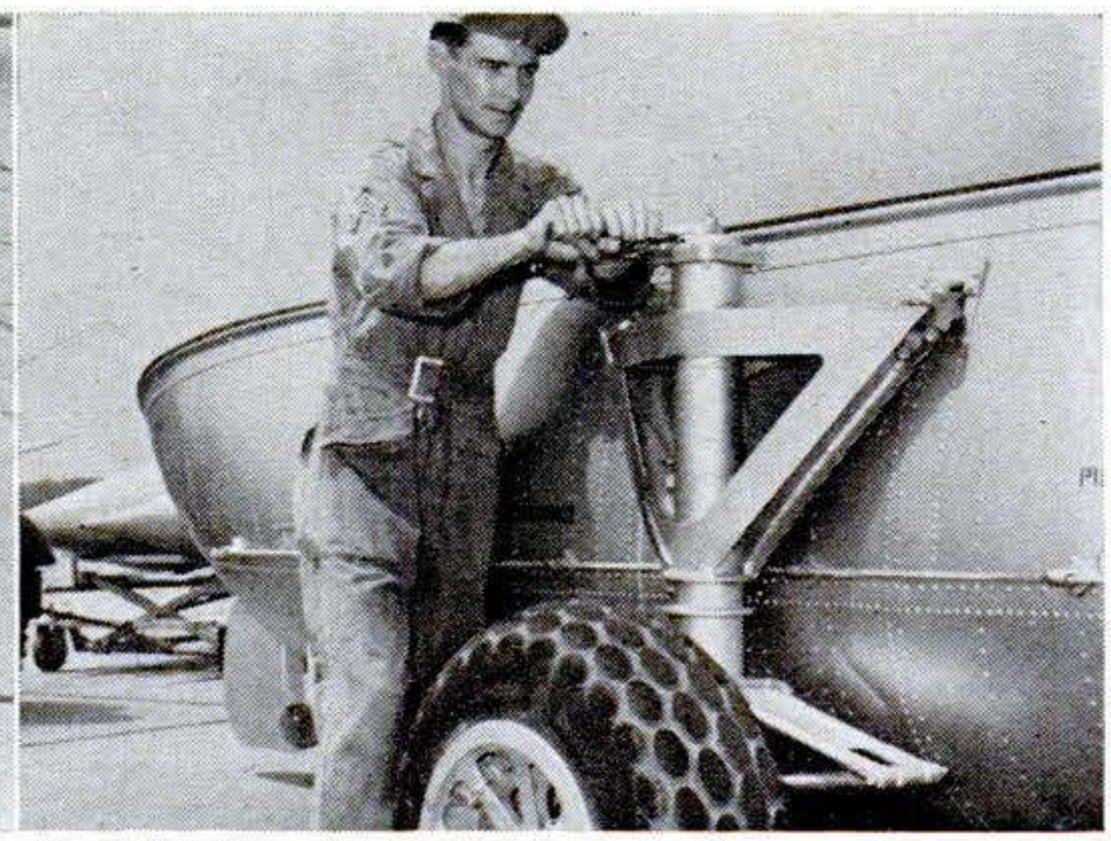
Hull of rescue boat is formed by 20 watertight compartments. Others provide storage for food, medicine, fuel. Nylon weather canopy fits into groove, indicated by pencil, inside gunwale.



Boarding ladder unfolds from the hull when spring catch is released by tug on line that can be reached from the outside by men swimming or riding rubber raft alongside the boat.



Three hoops form supporting frame for weather canopy. Square dark area on hull is boarding-ladder hatch, painted red so that men in water will keep out of its way when it drops open.



Beaching gear for maneuvering boat into place under plane consists of three wheels on telescopic struts that lower or retract them when crewman turns jackscrew with rachet wrench.

To the lay eye, nothing has been forgotten. A lanyard switches on a light atop one of the self-righting chambers so that the boat can be spotted at night on the ocean surface. An inner wall around the cockpit provides compartments for stowage, water distillation, and food heating. Below-deck food lockers are waterproof. So are the engine compartment and engine-control panel. Miscellaneous equipment includes a sea anchor, fire extinguisher, compass, bilge pump, bow line, tool kit, salt-water soap, and a cockpit heater.

Use of the A-3 probably will not be limited to the rescue of bomber crews. It could come in just as handy in extending succor to commercial aircraft and to the ditched crews of the protective long-range fighter planes that accompany bombers on missions. END

New Metal for Kitchenware

STAINLESS-CLAD copper, a newly perfected material for cooking utensils, combines the desirable qualities of heat-conducting copper and tarnish-proof stainless steel. The composite metal is also recommended for ironers, radiator shells, freezer parts, and many industrial applications. Readily formed and welded, laminated sheets offered by American Cladmetals Company of Pittsburgh, Pa., consist of an inner layer of copper sandwiched between two firmly bonded exterior layers of stainless steel.

Balloon Rises 24.4 Miles

A NEW altitude record for free balloons was established recently, when a balloon carrying cosmic-ray instruments soared to a confirmed height of 129,000 feet—24.4 miles above the earth—during studies sponsored by the Office of Naval Research.

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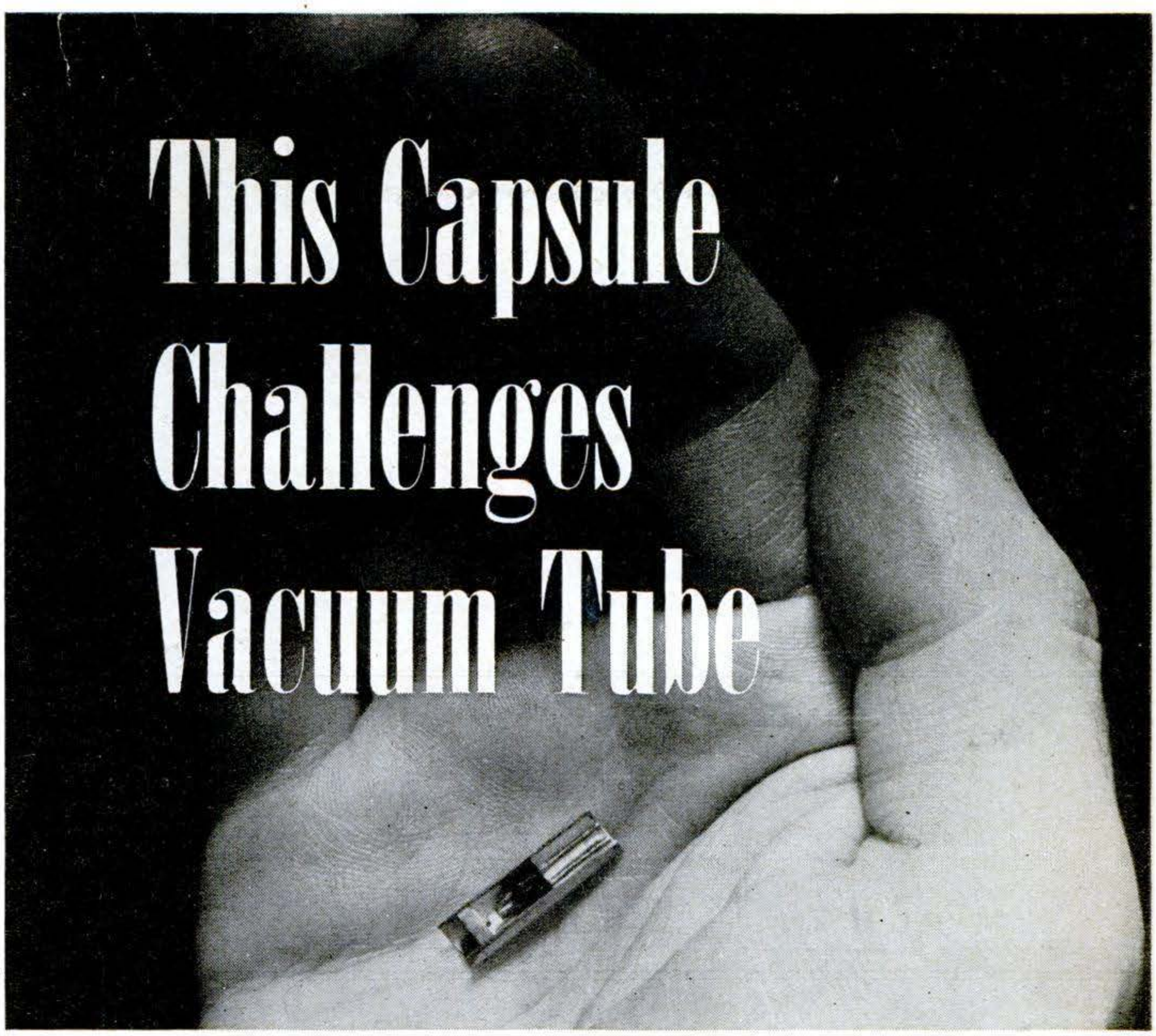
This Capsule Challenges Vacuum Tube



Transistor (shown with case cut away) uses new principle to amplify like vacuum tube.

Simple, tiny amplifier for telephones, radio, and television utilizes "holes" in atoms of rare element.

FOR the first time since its invention 41 years ago, the vacuum tube that runs your radio, operates welding machines, counts beans, opens doors, and supports the $3,500,000,000 electronics industry, has a rival. It is a tiny, seemingly simple gadget called a transistor.

A transistor can do nearly everything a vacuum tube can do—and then some. It amplifies, oscillates, and detects electric currents. It can amplify telephone conversations and television signals. It makes possible the construction of a complete, high-fidelity radio without any vacuum tubes.

The transistor has no vacuum, grid, plate, or cathode. Since there is no cathode to shoot out electrons when hot, there is nothing to heat up. The transistor starts to work the instant the current flows. Partly for this reason, the transistor uses less power than a vacuum tube. It requires only about a tenth as much as a flashlight bulb.

The device that may start a revolution in electronics is smaller than a paper match. Inside its little, cylindrical metal case, three wires are connected to a crystal of germanium, a rare element with curious electrical properties. Prompted by a signal from one of the three wires, the germanium acts as a valve controlling the flow of current between the other two wires.

This valve causes the voltage and amperage in the output circuit to vary as they do in the input circuit. Thus by transferring the signal from one circuit to another, its strength may be increased as much as 100 times.

The first use of the transistor, say the Bell Laboratories scientists who invented it, probably will be in their own business

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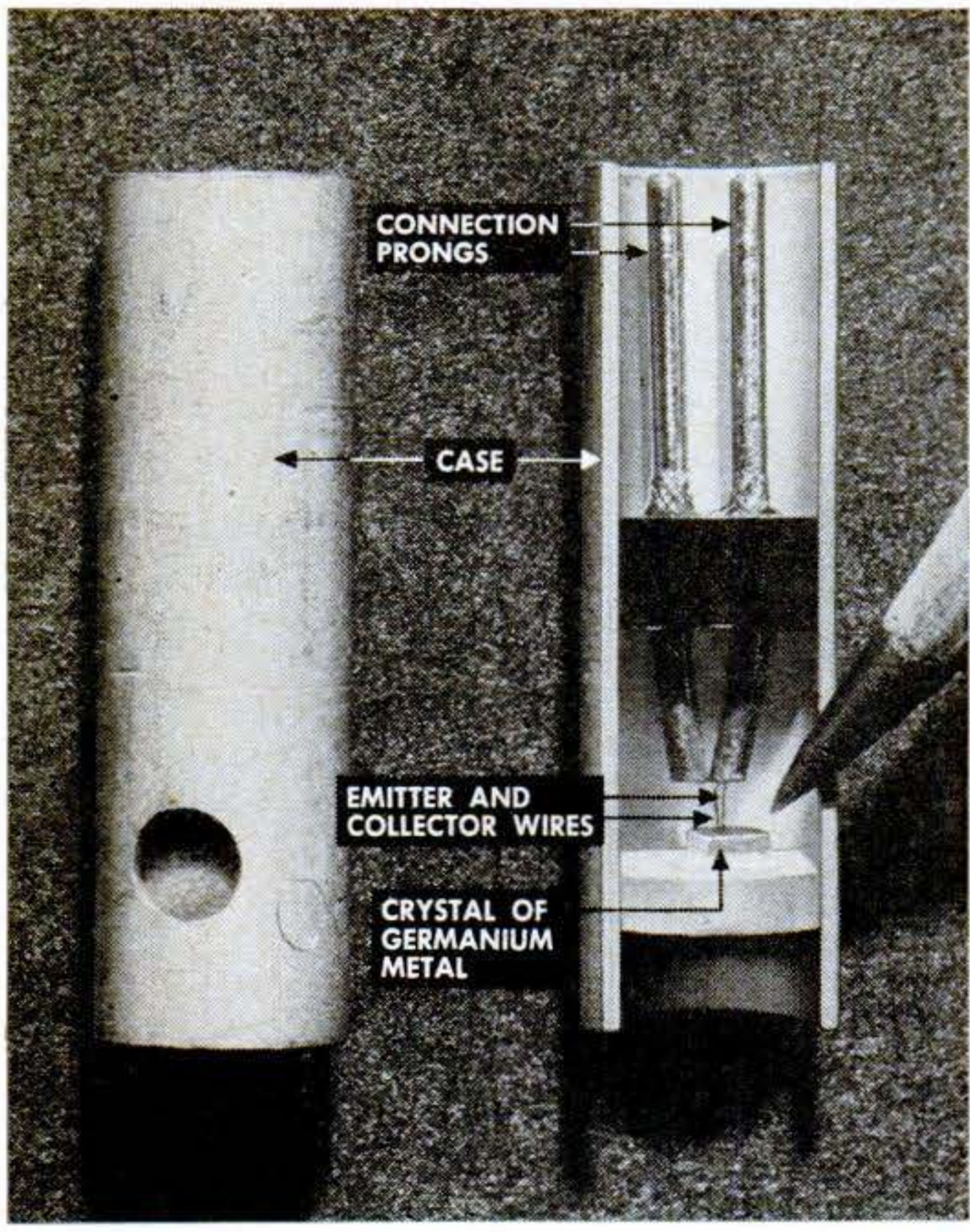
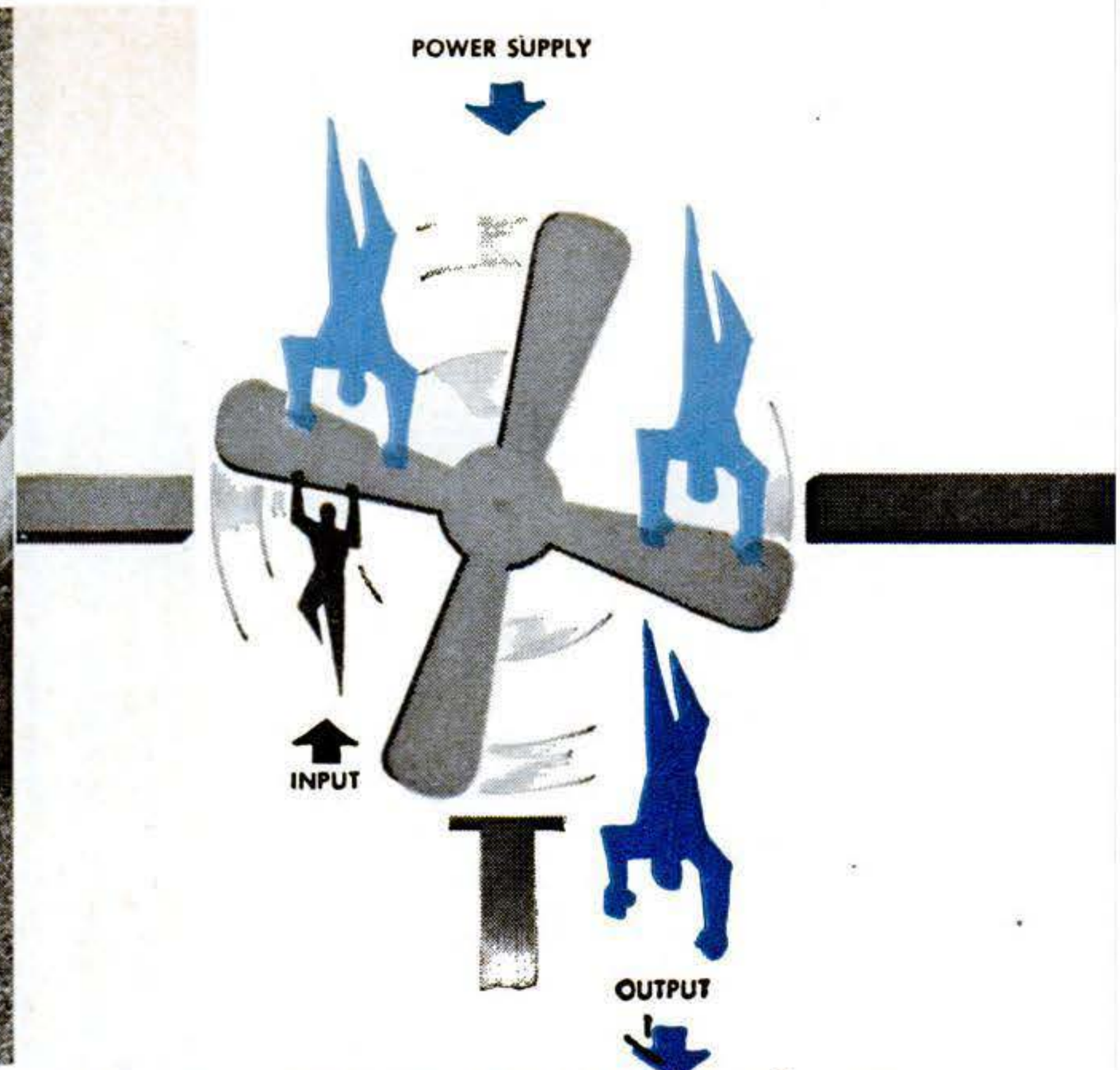


A transistor ready for use is shown at left above, while at right is one with its cover cut away to show the key parts—the two tiny wires and block of metal under the pencil point. A third wire is out of sight under the block. Transistor is about one-third the size shown here.



Like any amplifier, transistors control great power with weak input signals. Output circuit is like a crowd of strong men pushing the same way on both sides of a turnstile. None pass through, unless a weak man pushing the other way upsets the balance. Then strong men pass.

of telephone transmission. Phone calls fade out after traveling on wires a few miles and must be built up again by vacuum-tube amplifiers called repeaters. Transistors can do this building-up without consuming as much power as the vacuum tubes. This will permit the installation of more repeaters, improving service.

Television, too, will benefit. Transistors can amplify over a wide range of frequencies, including the very high frequencies used for video. So, by using transistors as repeaters, television programs may be transmitted over ordinary telephone wires. This would provide a simple means of linking many cities into a television network, just as the telephone lines now furnish radio networks. At present, television can be sent from city to city only over coaxial cable or microwave radio relay systems.

Transistors also may help make many small, portable devices—such as "wristwatch" radios and the tiny amplifiers used by the hard-of-hearing—still smaller and lighter. Since transistors require less power than even the smallest vacuum tubes, they can be used with smaller batteries. And in hearing aids and tiny radios it is the batteries that take up most of the weight and space.

Whether transistors will ever replace the vacuum tubes in your home radio will probably depend most on how much it costs to make them. Bell scientists won't even guess what you will have to pay for a transistor, but the simplicity of the device indicates that mass-production economies will be possible, and plans already are being made for a pilot plant to manufacture the new devices.

It is an interesting sidelight to history that the telephone company, which played such a big part in the invention and development of the vacuum tube, should also conceive the device that may replace it. Dr. Lee de Forest, the electronics genius who invented the amplifying vacuum tube, was a member of the telephone company staff until a few years before he patented his "audion." And he sold a license for telephone use of that patent to his former employers.

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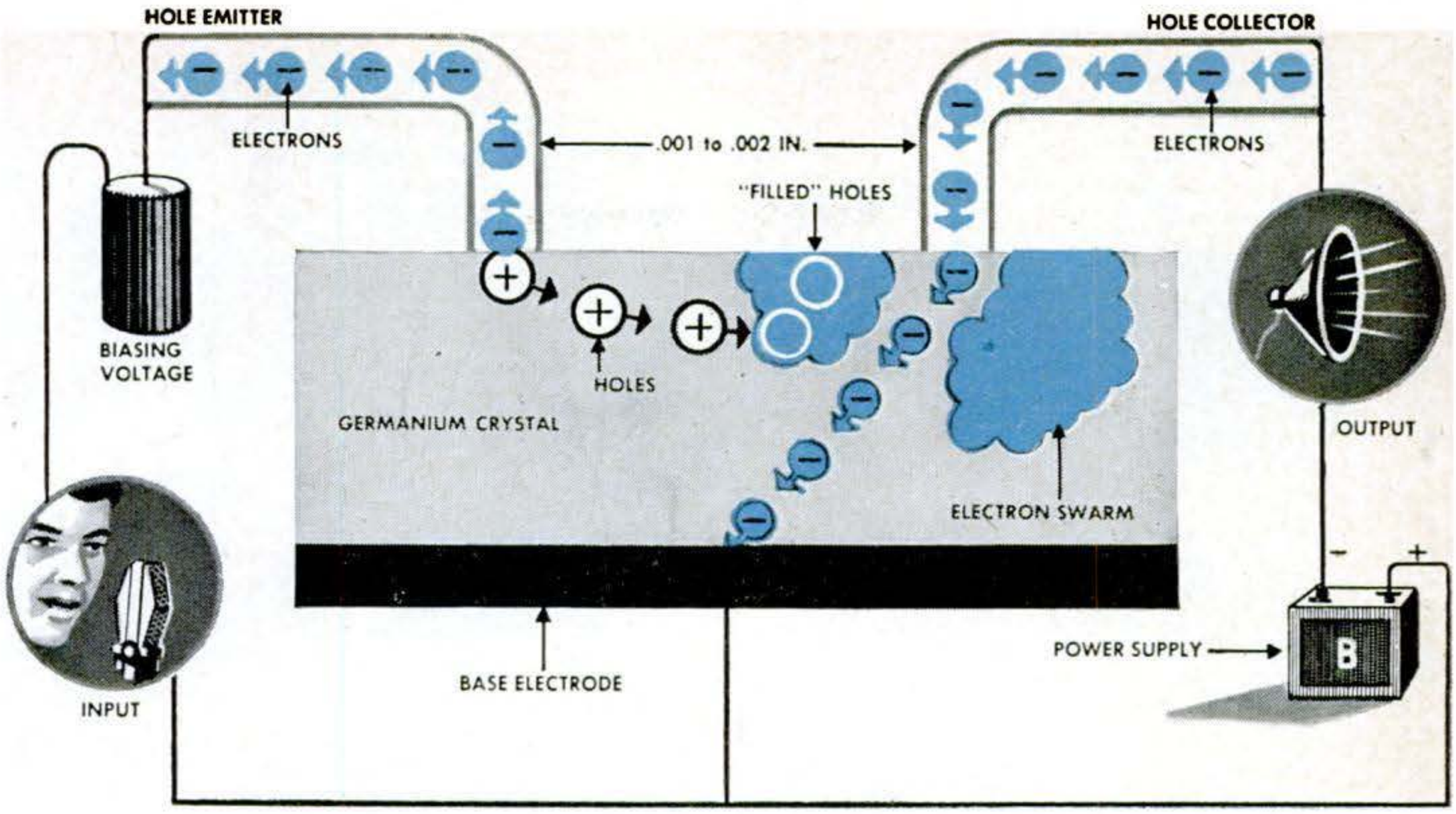

Exactly how transistor works is still debated, even among Bell Labs scientists. One explanation suggests electrical "holes" are formed in crystal of semi-conducting germanium metal. Input signal pulls electrons away from atoms near emitter point, leaving empty spaces in atoms. These travel through crystal like bubbles. "Holes" are positively charged and neutralize the swarm of electrons that ordinarily impedes flow of other electrons from collector wire, clearing a path for electrons to stream to the base electrode. This stream is amplified current.

Now, nearly half a century later, a new generation of telephone physicists has found a radically different method for amplifying electric currents. This new method, utilized in the transistor, depends on the strange way in which certain materials—the elements germanium and silicon, oxides of copper and other metals, and a few additional compounds—react to electricity.

Germanium, for example, is a hard, brittle, silver-grey metal that is in between a good conductor and a good insulator—physicists class it as a "semi-conductor." It had little commercial value until someone discovered that it conducted current much better in one direction than in the other. If you apply alternating current (which changes its direction many times a second) at one end of a germanium crystal, direct current (which always goes in the same direction) comes out of the other end. In other words, it is a natural rectifier. Germanium crystals are widely used for this purpose now in radios and other devices.

Such interesting properties have made germanium and its sister materials the subject of much research in laboratories all over the world. At the Bell Telephone Laboratories, Dr. William Shockley, a top-ranking physicist, suspected that germanium's ability to carry electricity might be changed by applying an electric field to it. A varying field would induce a varying current, making the germanium an amplifying device. But this apparently good idea did not work at first.

The task of finding out why was assigned to Drs. John Bardeen and Walter H. Brattain. They developed a new theory to describe the action of germanium. When translated into practice in the workshop, this theory became the transistor, which works very well indeed.

Drs. Bardeen and Brattain explain how the transistor operates by using the concept of electrical "holes." Ordinarily, electric current is considered to be a stream of electrons, very tiny atomic particles each carrying one piece of electrical charge. But if an electron is moved away from the atom to which it belongs, the atom is left with an empty space—a hole. These holes can

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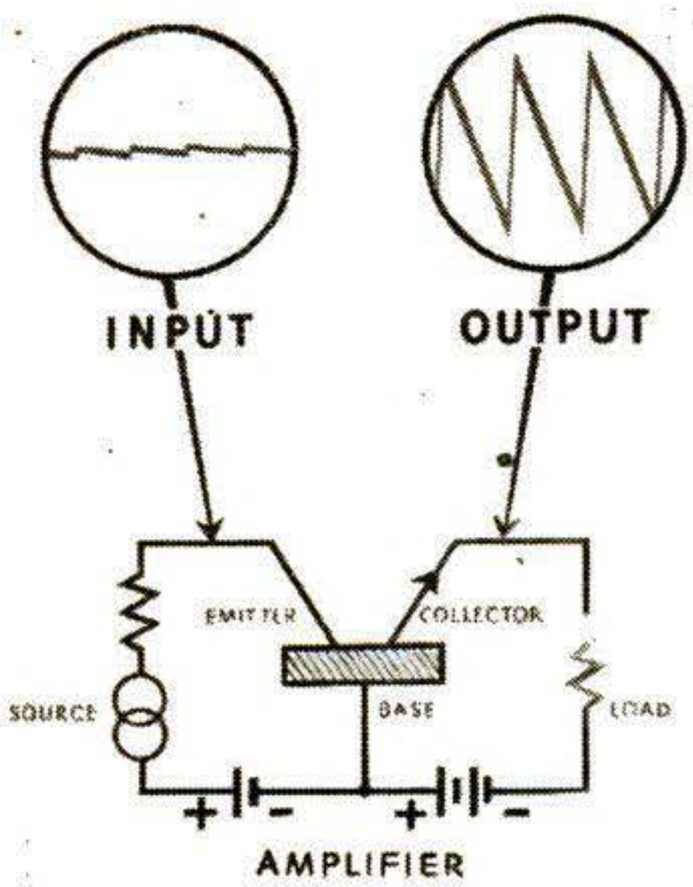
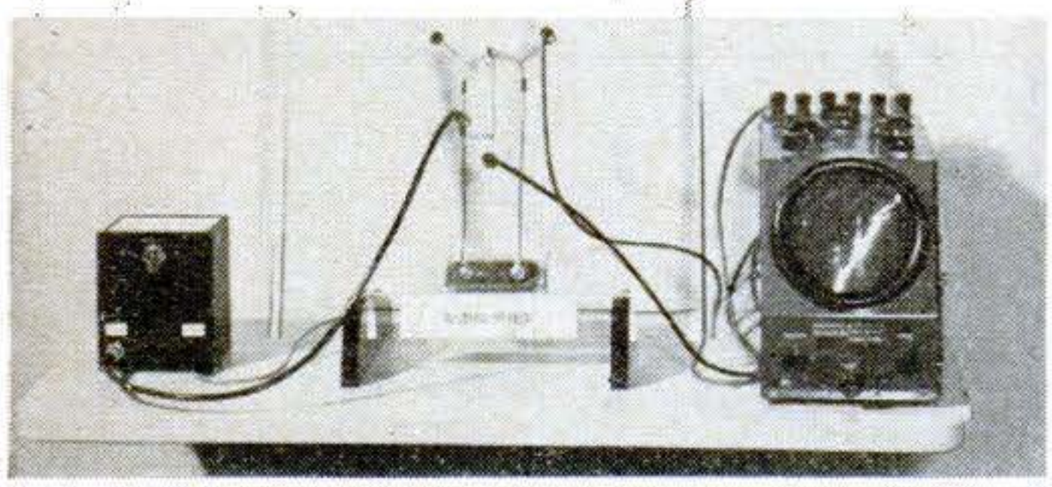
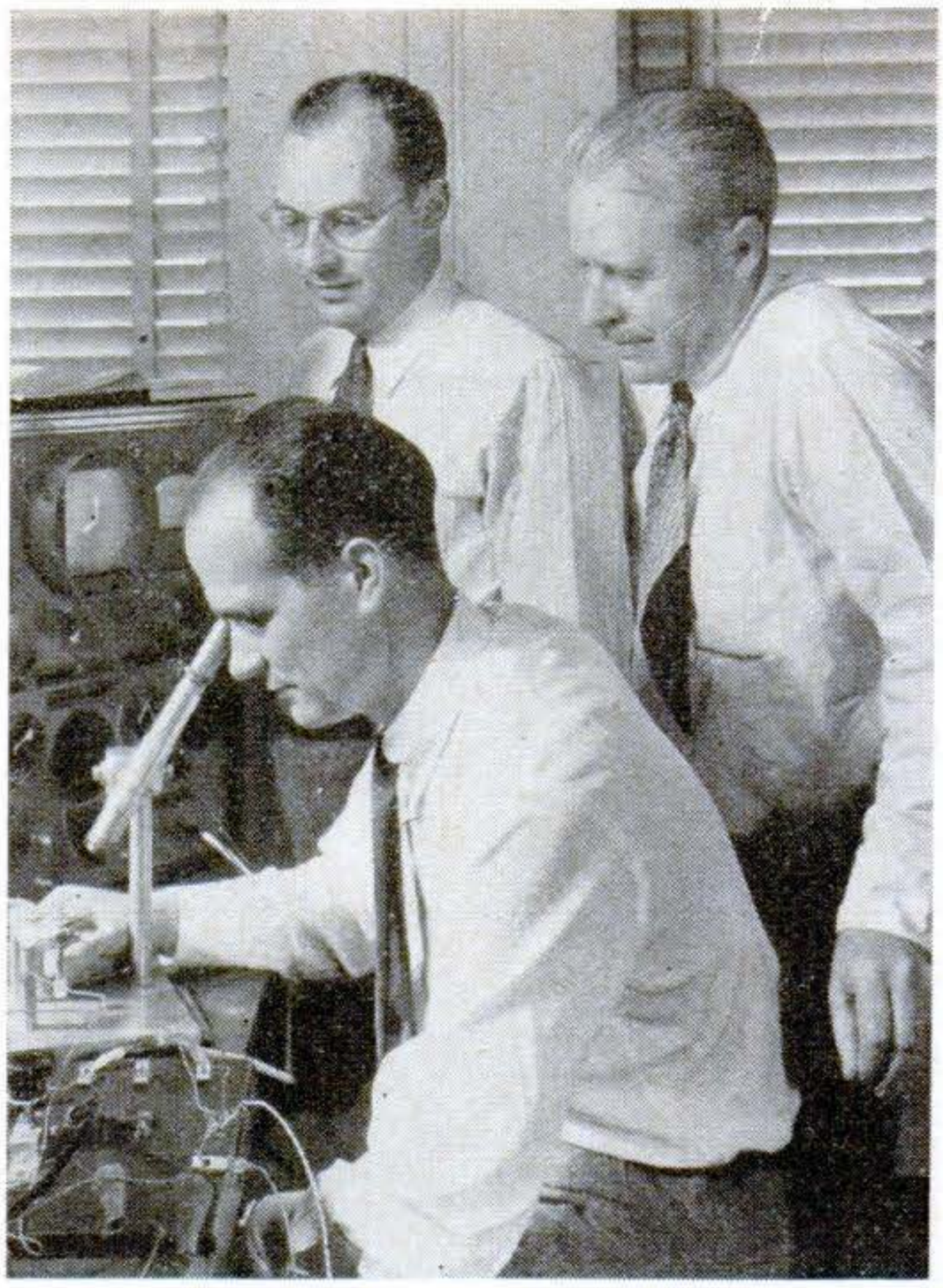




Display panel (above) shows transistor used to amplify pulse signals, one of many possible applications. Complete radios have been made with transistors replacing all vacuum tubes.



A three-man team of Bell Laboratories physicists developed the transistor. Left to right are Drs. William Shockley, who directed the work, John Bardeen, and Walter H. Brattain.

move around from atom to atom just as bubbles move in a glass of water. And a stream of holes can be produced in a block of germanium just as a stream of bubbles can be produced in water. Since a hole lacks the negative charge of an electron, it is positive and will move from a positive electrode to a negative electrode. A hole can be considered to be a piece of positive electricity, just as an electron is a piece of negative electricity.

In a transistor, the weak signal pulls electrons out of the germanium atoms near the point of the emitter wire. This loss of electrons creates holes that can move around near the surface of the germanium, but only as far as .001 or .002 inches from the emitter point.

The point of the collector wire is placed at this distance. It is maintained at a high negative potential—the battery is trying to force electrons out of the wire and into the germanium crystal. But the strange properties of germanium prevent this. The electrons bunch up around the collector point, becoming so crowded that they prevent the flow of additional electrons from the collector and there is no output. When holes reach the collector point, however, they neutralize part of this bunch of electrons, clearing a path for more electrons to flow out of the collector. Some of the electrons from the collector fill up the holes and are neutralized, but the electrons are so numerous and moving so fast that many more rush right by the holes and reach the base electrode. The electrons that get past the holes make up the output current.

Since the number of electrons able to flow out of the collector depends on the number of holes reaching the collector—which in turn depends on the signal—the output is patterned exactly after the signal. And since more electrons flow out of the collector than holes to the collector, the output is larger than the signal. Thus, the transistor amplifies the signal. END

New Element Heavy as Lead

TECHNITIUM is a radioactive metal whose density of 11.46 makes it just about as heavy as lead, the Argonne National Laboratory reports. First tests of the physical properties of this new synthetic element have been made possible by its recent preparation in visible amounts.

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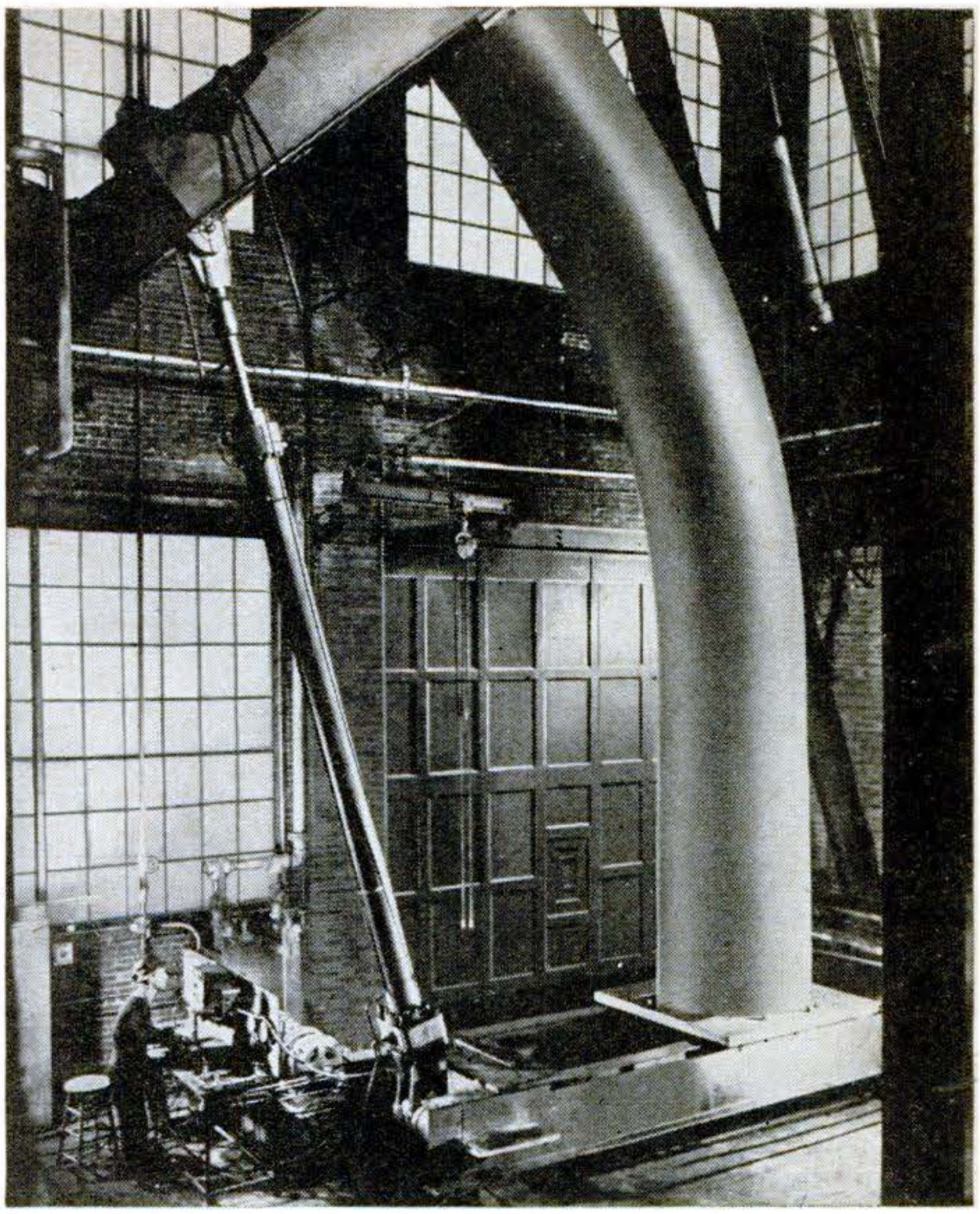
Hydraulic Giant Bends 5-Ft. Pipe

THE picture at right unveils the world's champion pipe bender: a two-armed hydraulic giant that makes smooth curves in steel tubes big enough to walk through.

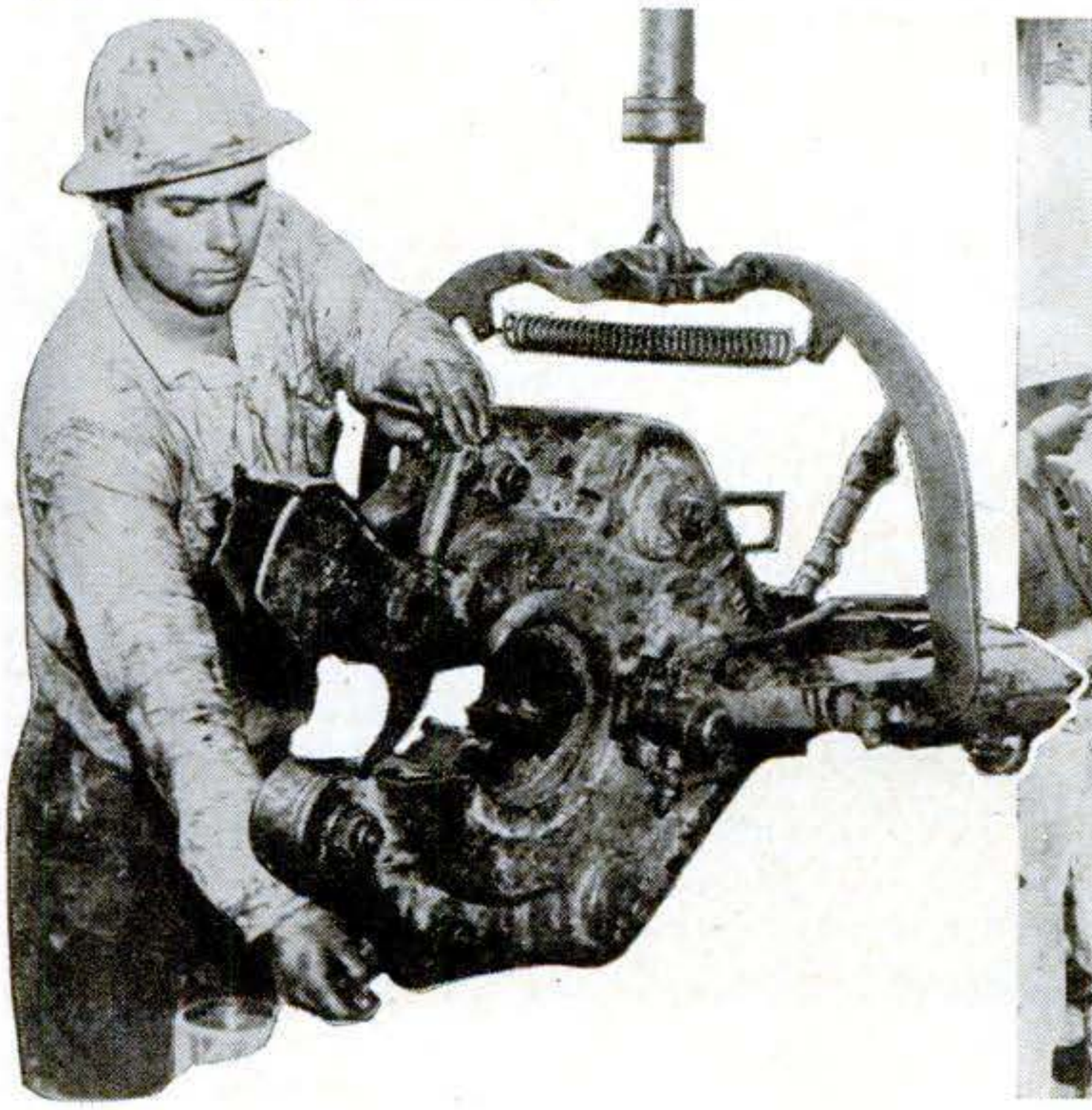
Shown bending a 50-inch duct for a petroleum-cracking plant, it has handled 60-inch pipe. And it is believed to be capable of bending diameters up to 100 inches—three times the size of the biggest pipe bent in one piece before the M. W. Kellogg Co., of Jersey City, N. J., developed this machine.

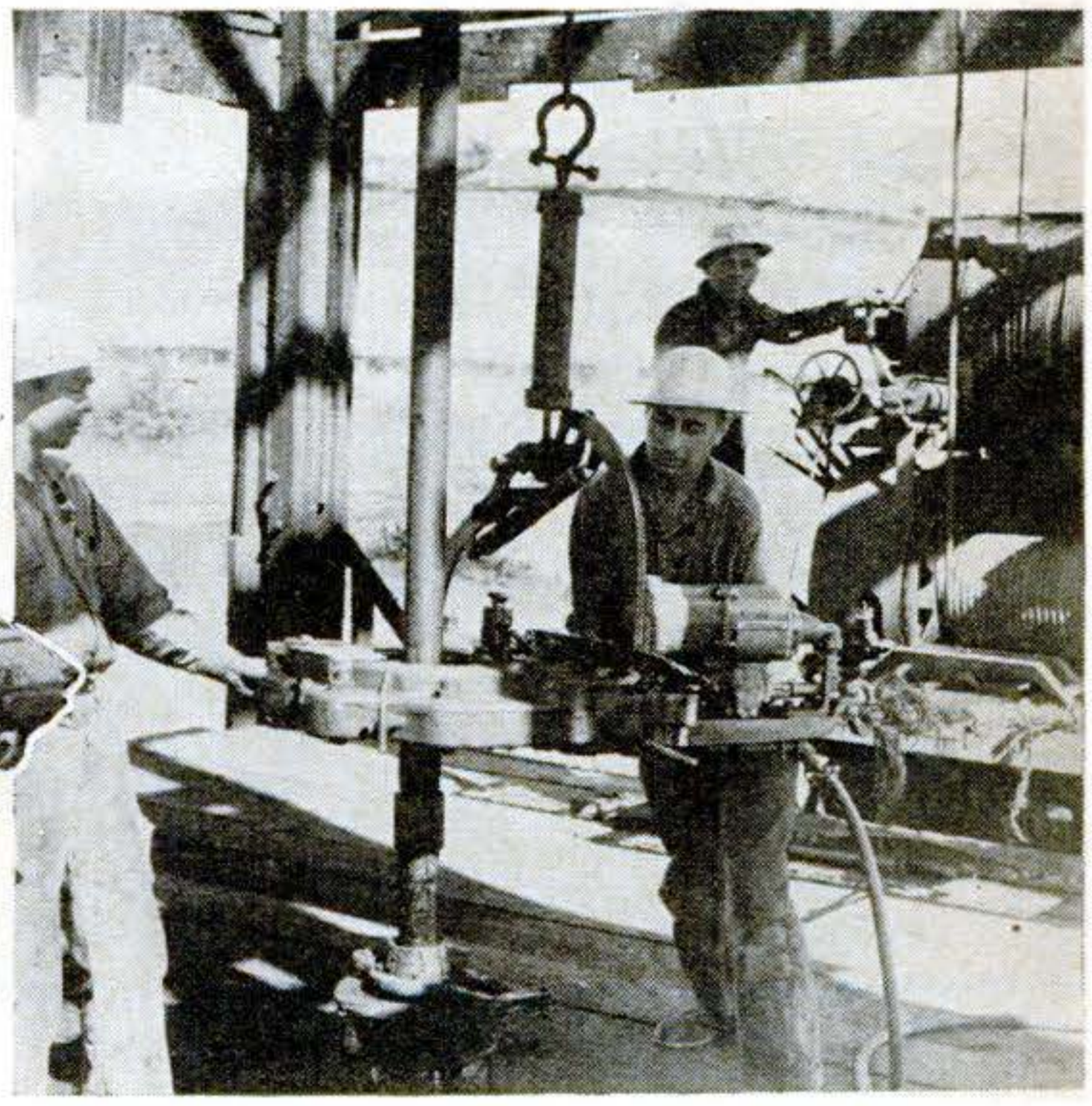
The pipe is anchored to the floor and heated to 1,450° F. with rings of gas burners. The arm at left then pulls down on the cross beam with a force of 5 tons, while another at right pushes up.



Air Motor Twirls Huge Pipe Wrench

THIS big tong, built like a Stillson ® wrench, was developed to speed the assembly of oil-well tubing. It is believed to be the fastest wrench ever made. Reversible simply by flopping it over, as shown at left below, it can be used to tighten or unscrew threaded pipe. Its jaws are twirled at 16 or 60 r.p.m. by a compressed-air motor with a two-speed chain drive. The unit is made by the Byron Jackson Co., of Los Angeles.





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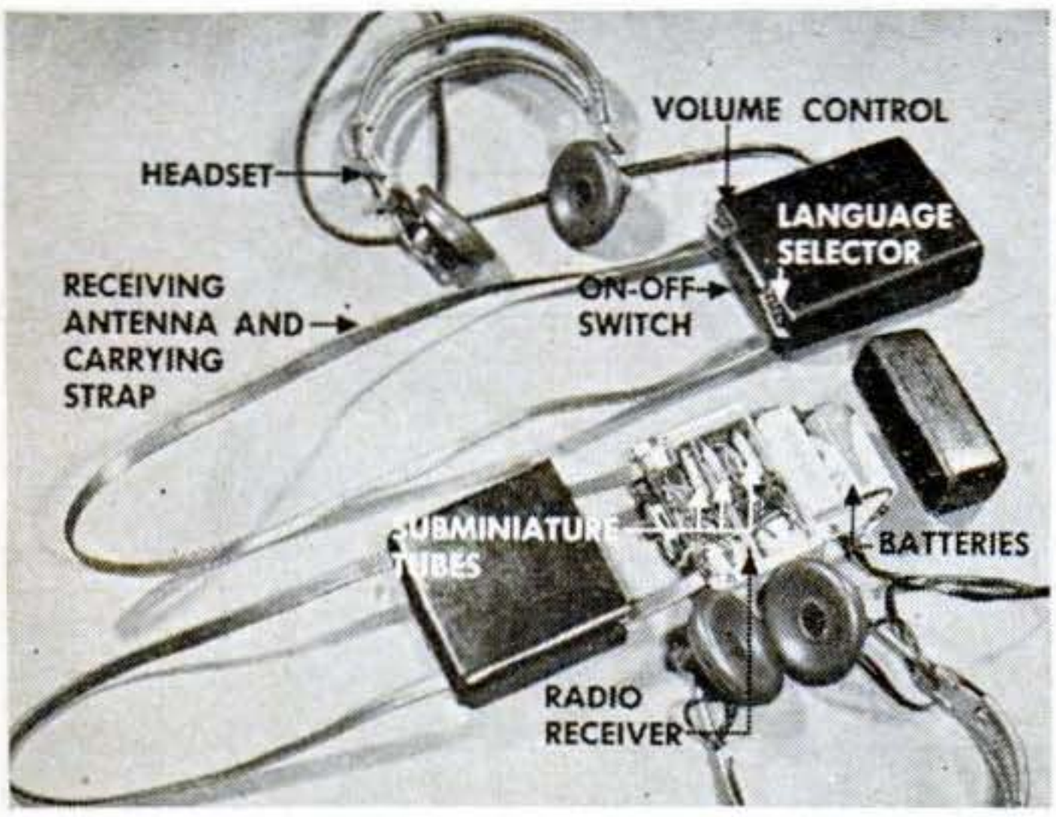
This switchboard helps nations confer. It is in a soundproof booth overlooking the horseshoe table around which the United Nations Security Council meets. The engineer operating it controls the delegates' microphones and adjusts volume for speaking units and recording devices.

Wiring the UN for



Walkie-hearie is a tiny, battery-powered receiving set. A switch on the top of the case tunes it to any of six different frequencies.

Latest electronic devices overcome barriers of language and distance in this complex United Nations system.

By Martin Mann

PS photos by Hubert Luckett

MAYBE you live in Kansas. Or Sweden. Or Afghanistan. Yet no matter where your home, you can still hear what's happening at United Nations meetings—and in your own language. The world's most complex radio network, broadcasting in 23 different tongues 25 hours out of every 24 (thanks to overlapping programs) makes this possible.

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Reporters and officials use walkie-hearies to listen to proceedings in whichever one of six languages they prefer. Bob Manning, United Press man, is shown adjusting one. The interpreters, broadcasting instantaneous translations of everything said, are seated in booths at rear.

World Listening

The hub of this globe-circling network is now a reconverted war plant on Long Island, a few yards beyond the city limits of New York. There, in the temporary headquarters of the United Nations, every technique of modern electronics is being used to convey to every land in the world news that effects every one of its people.

Most of the equipment is standard—anybody can order it from a catalogue—but it is used in new and unusual ways. Never before has a governmental body relied so much on radio waves and vacuum tubes.

Casual visitors to Lake Success, however, see little of this communications machinery. So let POPULAR SCIENCE take you behind the scenes, into the workshops of the scores of engineers who operate it.

The words spoken by a UN delegate travel a long and torturous road before they come out of a loudspeaker in Czechoslovakia or Iraq. The first turn in this road is a control room in one of the booths that every visitor sees from the gallery of the Security Council chamber. There an engineer sits at a console. Watching the Council in action below him, he adjusts the switches and "pots" that control all the microphones in the room. When a delegate prepares to speak, the engineer clicks on the nearest mike, then switches back to the Council president when the delegate stops.

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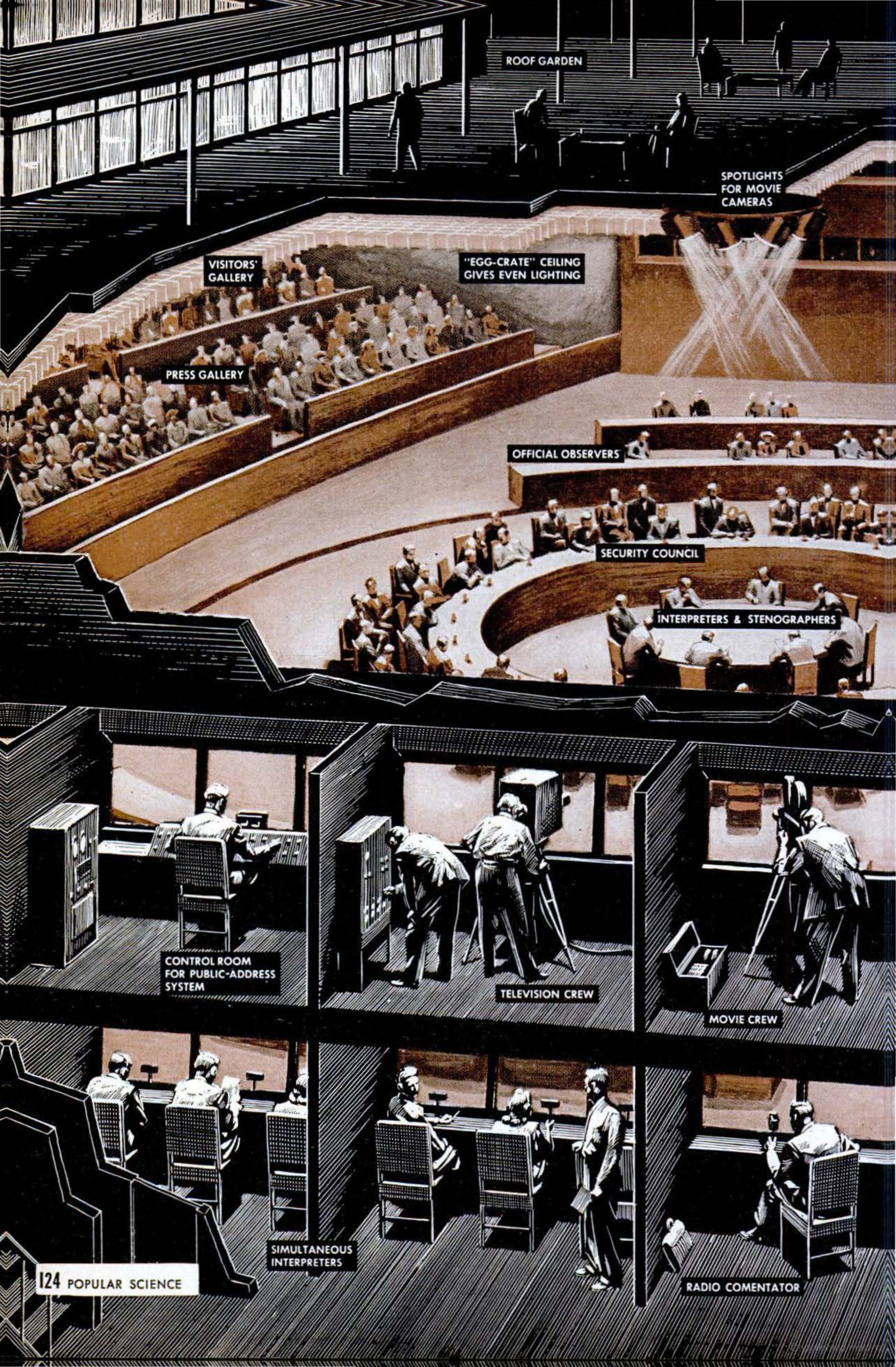
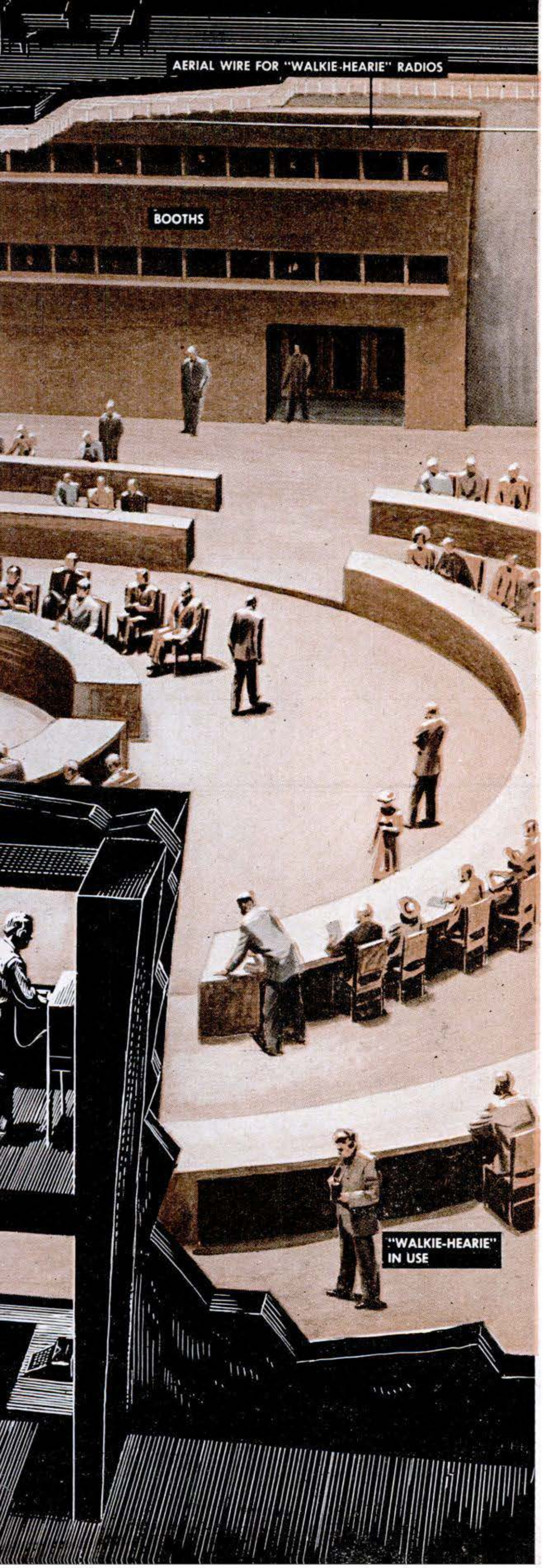

ROOF GARDEN
SPOTLIGHTS FOR MOVIE CAMERAS
VISITORS' GALLERY
"EGG-CRATE" CEILING GIVES EVEN LIGHTING
PRESS GALLERY
OFFICIAL OBSERVERS
SECURITY COUNCIL
INTERPRETERS & STENOGRAPHERS
CONTROL ROOM FOR PUBLIC-ADDRESS SYSTEM
TELEVISION CREW
MOVIE CREW
SIMULTANEOUS INTERPRETERS
RADIO COMENTATOR



From the engineer's control panel, the lines travel down to an amplifier room directly below. This large, brick-walled room is filled with racks of electronic equipment that amplify the output of every microphone in the UN's vast system—there are mikes in conference and committee rooms as well as in the principal chamber. The amplified speeches then go out to loudspeakers in the meeting rooms and press lounge, to listening sets in several of the UN offices, and to the adjacent recording room.

Every word spoken in a United Nations meeting is preserved for posterity on large phonograph records. These verbatim recordings will enable the history student of the future to *hear* exactly what was said, the way it was said, just as though he had been present. He no longer will have to rely on dull—and possibly misleading—written records made from stenographic notes.

History Broadcast from Platters

The verbatim records also turn up in the UN's radio programs. The most important, dramatic sections of the speeches are broadcast from the records, bringing the original speaker's own voice to the radio audience. Many of the UN programs are completely recorded—music from records, plus parts of speeches from other records, and commentators' voices are combined in one program record, which is then played over the air.

The wide use of completely recorded programs simplifies the radio operation, permitting the identical show to be broadcast at various hours to allow for the difference in time throughout the world. Thus people in Norway, India, and the Philippines can all hear the same breakfast newscast at breakfast time.

The UN radio-news desk, largely the creation of its chief, Cesar Ortiz, is geared to operate as fast as a tabloid newspaper's city desk when necessary. It is in a small office of the press section. Two reporters sit at adjacent desks. One wears earphones plugged into the UN-wide intercommunication system and types notes on the speeches he hears. As fast as he finishes a page, his partner takes it and rewrites the notes into news bulletins, typing them directly on a special duplicating sheet. As quickly as *he* finishes a page, a girl grabs it and runs off copies on a duplicating machine. These copies are then distributed to the various language sections of the radio division, which prepare news broadcasts in 23 different

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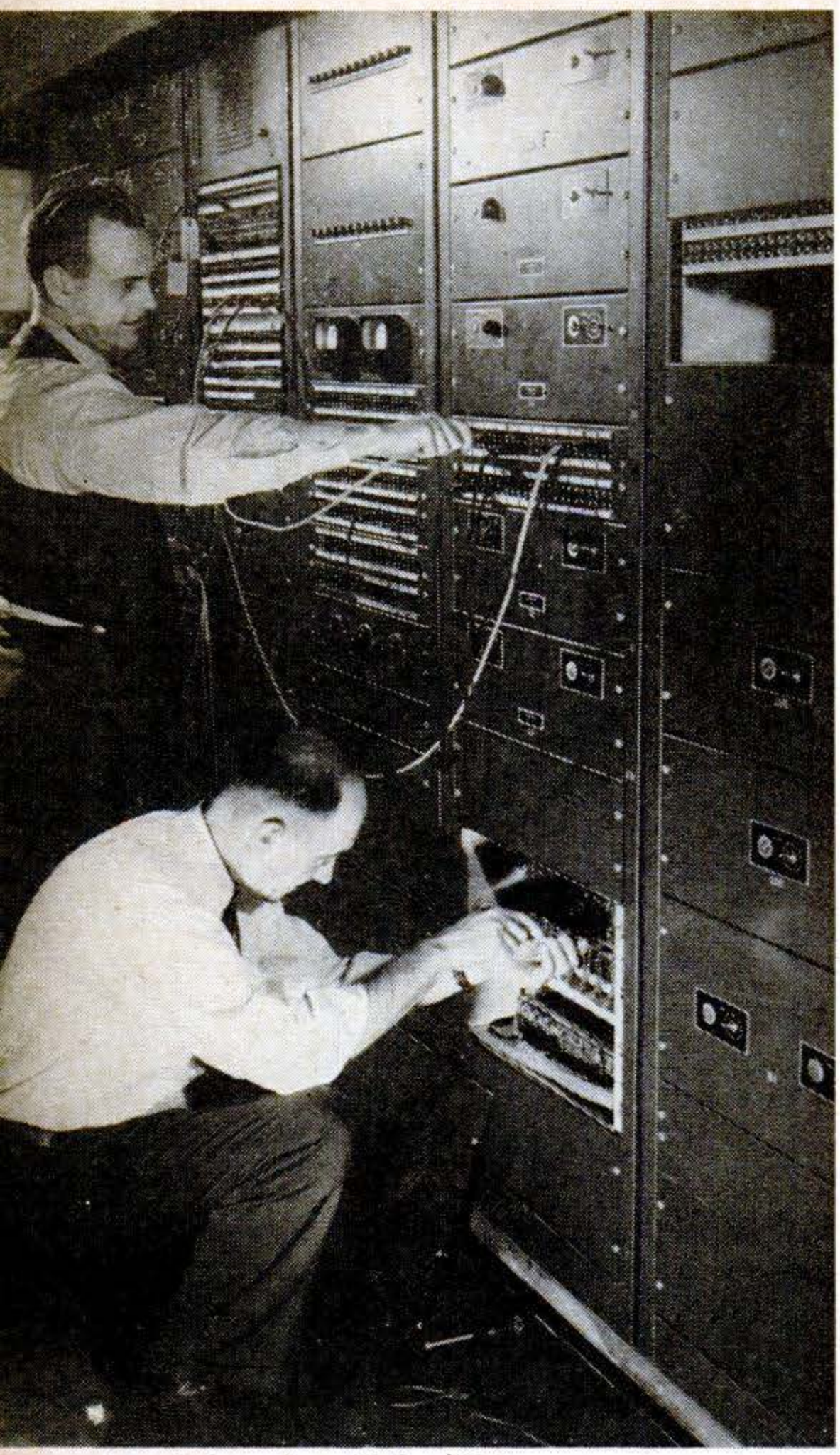

Amplifiers for all the UN's microphones—every meeting room has a mike for each delegate plus extras for translators, etc.—are located in this special room. From this point the lines go out to the complicated public-address system, broadcasting studios, and recording room.

tongues, including such rarely heard languages as Pushtu (Afghanistan) and Amharic (Ethiopian).

Most UN broadcasts, both recorded and "live," originate in the five studios at Lake Success. From there they travel over wires to whatever transmitters the UN can beg, borrow, or rent. The largest number of shows are carried by the State Department's big network, the World-Wide Broadcasting Foundation, and the Canadian Broadcasting Corporation, but some are relayed by RCA to a station in Tangiers, North Africa.

All these transmitters operate in the 6-to-22 megacycle band reserved for international broadcasting, and can be picked up by anyone with a short-wave receiver. Most listeners, however, hear UN programs on the standard broadcasting band from local stations in their own areas.

UN Reaches Fourth of World Listeners

These local stations can get the programs in any one of several ways. They may pick up a short-wave transmission and rebroadcast it directly, or record it for broadcasting later. In the United States, 113 stations are fed UN programs over wire lines. Overseas, many stations that have difficulty receiving the short-wave programs are mailed program recordings—500 such records are sent from Lake Success every month. With this varied system of program distribution the UN now reaches an audience of about 100,000,000 persons—about one out of every four radio listeners in all the world.

Just outside the Security Council's chamber is the "shack" of an amateur radio station, K2UN, operated by volunteers. It is the first station actually owned by UN, and

Top-level UN officials, such as Dr. Ivan Kerno (below), chief of the legal department, have consoles linked to the public-address system. They can keep in touch with the progress of important debates without leaving their offices by simply turning from their desks and tuning in.

News of UN activities is organized into radio programs in 23 different languages, including the Chinese being written by Mrs. Chang (below). She can "cover" meetings from her desk, since the Chinese section has a headset wired into the extensive public-address system.

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its central position in headquarters symbolizes the importance the organization's officials attach to radio.

Construction of this ham station was the first small step toward the creation of a big, new network that will employ the newest radio techniques to reach every part of the world. The ham station, however, will not be abandoned even when the new system is completed. By keeping in touch with amateurs all over the world, UN officials will know how well their principal broadcasting system is operating. The hams, who already have played an important role in radio development, thus may contribute still more to the solution of the problem of world communications.

Headquarters of the proposed new system, to be owned as well as run by UN, will be in New York. The main station will have short-wave transmitters beamed at various parts of the world, a medium-wave transmitter for local use, and possibly FM and television transmitters.

A second large station is planned for the main European office of the UN, in Geneva, Switzerland. This station will pick up and rebroadcast over short and medium waves the programs originating in New York. It will also have studios for producing its own shows. A third station, intended purely for short-wave relay, will be located at some point in the Pacific, and a fourth may be set up in South America.

All these short-wave stations are expected to use the new method of single side-band transmission, which requires only half the available channel for any one program. The other half can then be used for something else—in the case of the UN, it will probably be employed to conduct interoffice business by teletype.

Additional teletype communication will be transmitted by frequency-shift keying, which permits both teletype signals and voice or music to be broadcast at the same time over the same frequency. Frequency-shift transmission sends the teletype signals as small changes in the frequency of the carrier wave. These frequency changes, while too small to affect a receiver tuned to the voice broadcast, are picked up by the special frequency-shift receiver and made to operate the receiving teletypewriter.

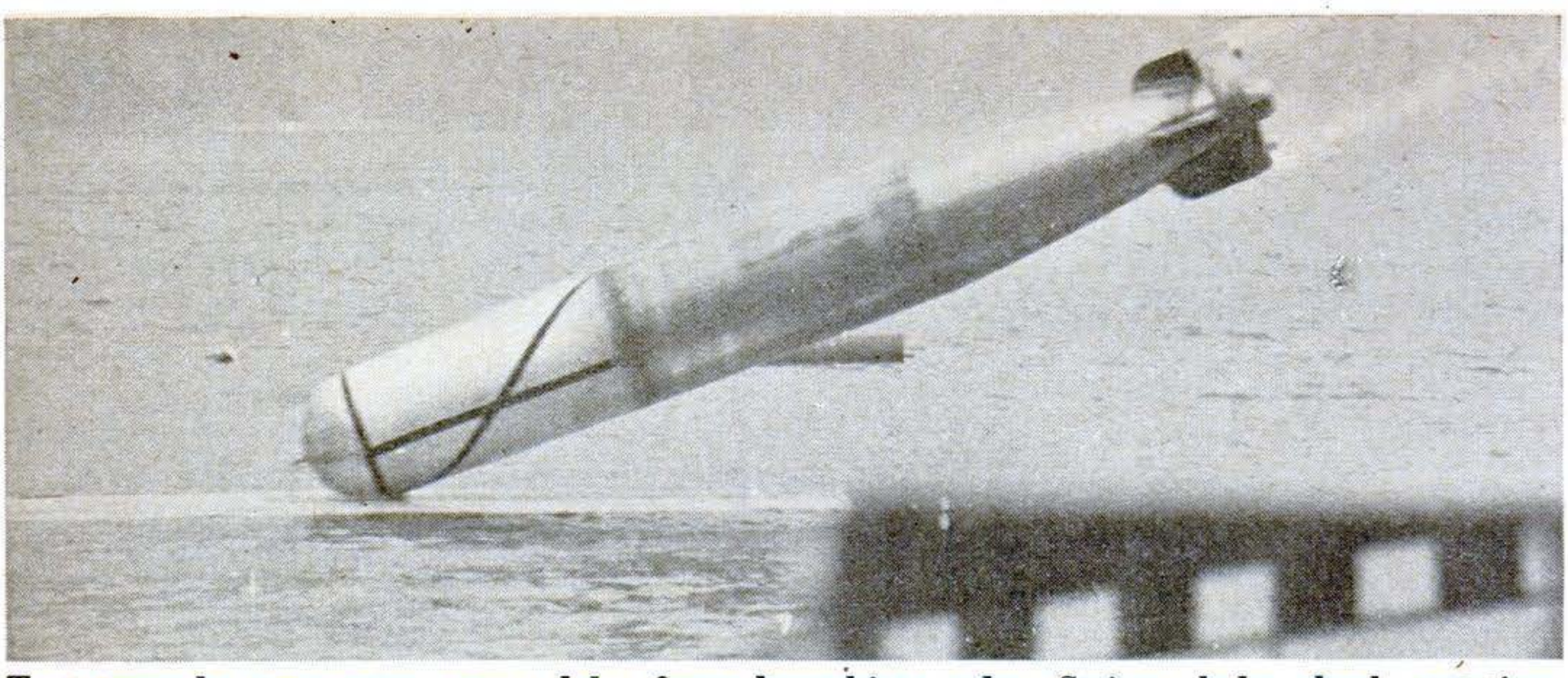
Technical Improvements Planned

Other modern techniques will make relay operations more dependable. The receivers that are to pick up short-wave transmissions for rebroadcasting will be designed to build up the carrier wave, reducing fading effects, and to expand the volume (which is ordinarily compressed in transmitting) to its original range. Groups of receiving antennas will be spaced to avoid fading, and the transmitting antennas will be of the movable, directional type, so that the radio energy can be concentrated in desired areas.

Part of this large-scale network is scheduled to be built in the near future. The first station will be constructed in New York, with three 50,000-watt short-wave transmitters. Studio facilities will also be greatly enlarged when the new permanent headquarters of the United Nations is built on New York's East River. The skyscraper office building will have a dozen small "talk" studios, several large studios, and a theater-type studio that can also be used for television broadcasts. END

Many of the UN's radio programs are broadcast from recordings, made in this modern disk-cutting room. Here, too, every word spoken in all meetings is transcribed—for the archives and for radio use. This system permits millions of people to hear the actual words of the delegates.

Records bearing complete radio shows are mailed all over the world to local stations, which rebroadcast from the recordings. Majority of the 100,000,000 listeners to UN programs get them from local stations, which retransmit either from records or from short-wave or wire relay.

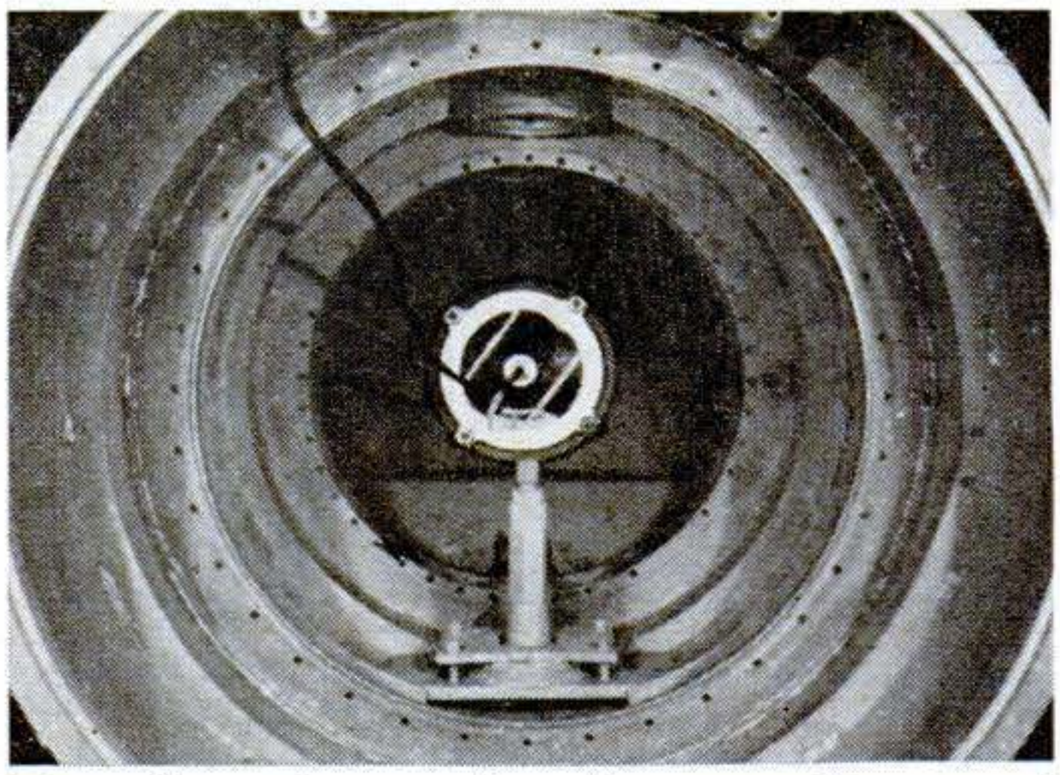


Test torpedo starts run across lake from launching tube. Stripes help check rotation.

Sound Times Tin Fish

SOUND waves are helping Navy scientists develop torpedoes that will go where they are aimed. These sounds, too high-pitched for the human ear, give a running account of the course and speed of test torpedoes. The Navy is using this data to design better controls.

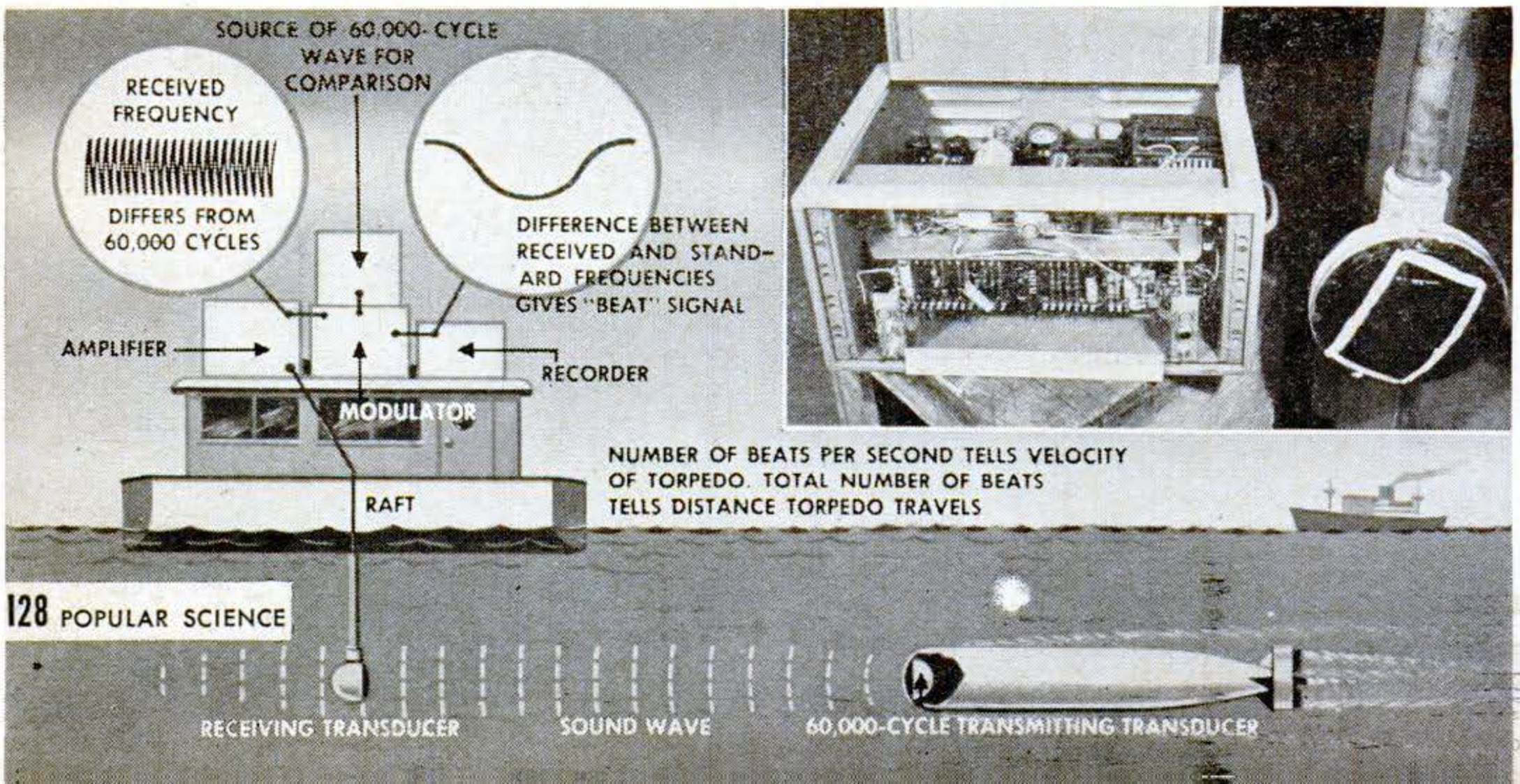
The experiments, at Morris Dam, Calif., (PS, May '48, p. 112), make use of the Doppler effect. This is the change in frequency of a sound wave caused by movement of the transmitter or receiver. The torpedoes carry a device called a transducer, which converts electrical waves into sound waves. The transducer sends a 60,000-cycle note through the water to a receiving transducer, hung under a raft, that changes it back to electricity and measures its frequency. The movement of the torpedo makes this frequency different from the original 60,000 cycles—how much different tells where the torpedo is and how fast it's going.



Transducer (center above), mounted in nose of torpedo, contains rochelle-salt crystal that turns electrical wave into 60,000-cycle sound wave. About 15,000 cycles is highest you can hear.

Sketch shows how moving transmitter shortens distance between waves, increasing frequency.

Receiving transducer (below), similar to transmitter, converts sound back to electrical wave.



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Rubber Makes Casting Mold

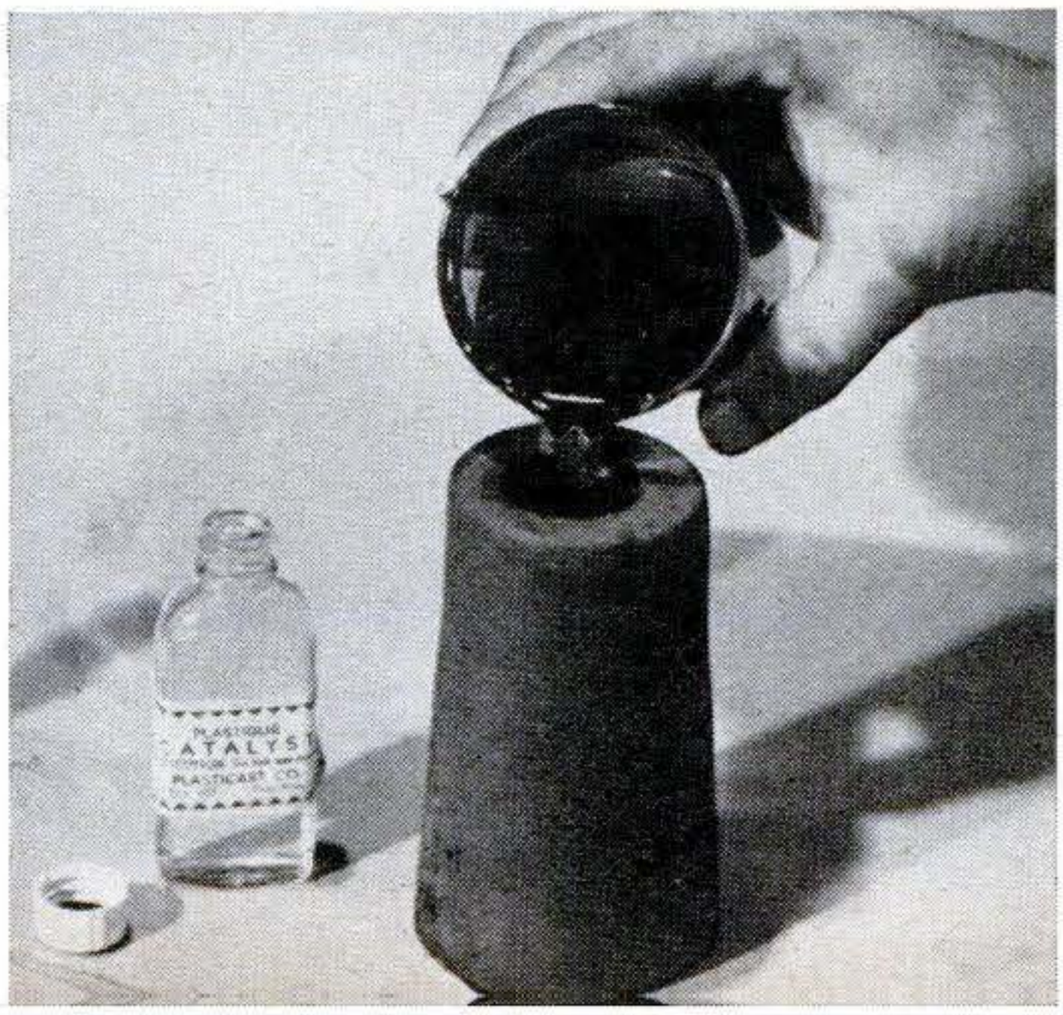
THESE pictures show a new way to cast art figures, toys, and other small objects in plastic or hard rubber without special tools or mechanical equipment. The process, almost as easy as pouring water out of a glass, can be used commercially or just for fun. It is based on the ability of a new material called Elastex®, made by the Plasticast Co., of Palo Alto, Calif., to control the coagulation of latex (liquid rubber) at room temperature.

Mold is made by stirring one part of Elastex® into two parts of latex, a little at a time, and pouring the mixture—resembling a thick chocolate malted—over object to be duplicated.

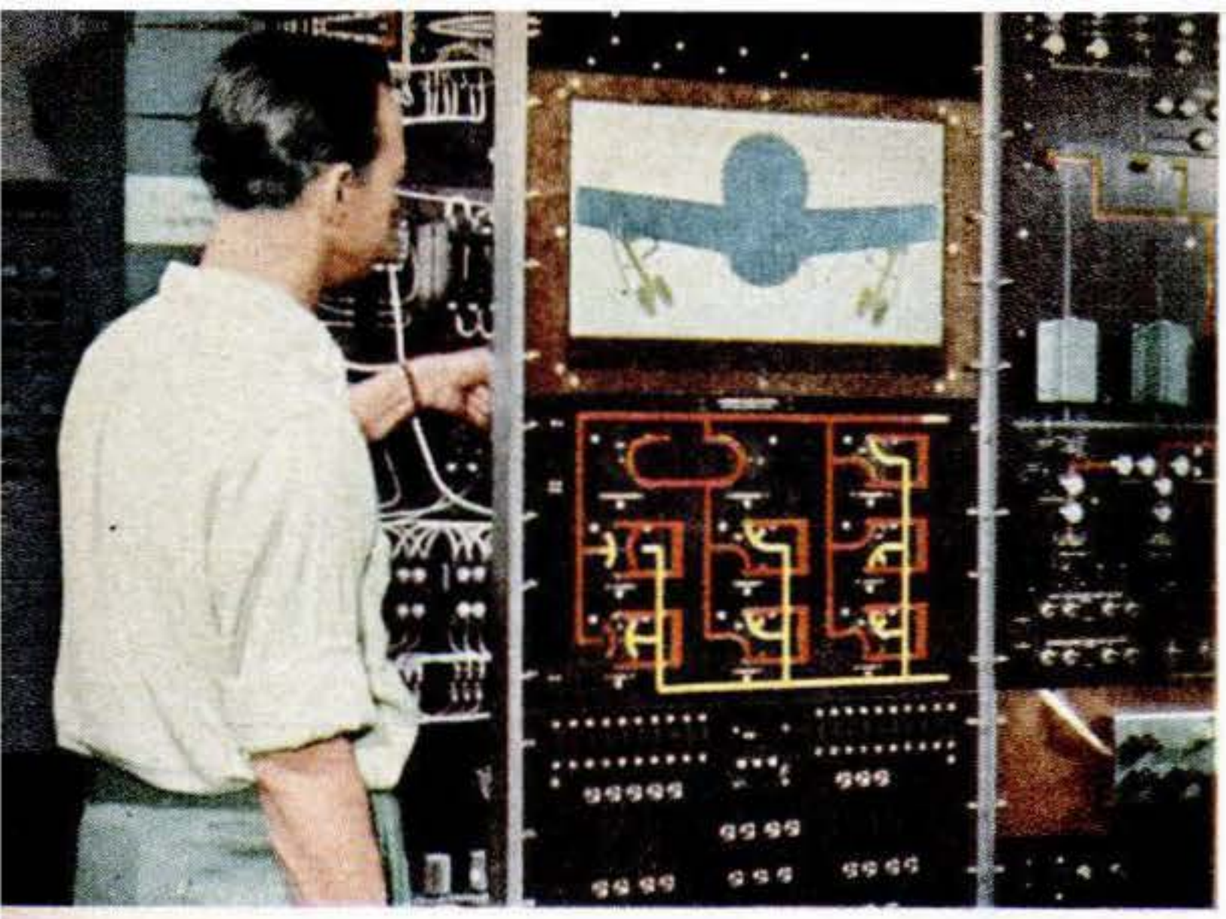
Mold solidifies overnight at room temperature or in 15 to 20 minutes in oven at 135° F. Baking improves mold by vulcanizing. It can now be pulled from glass with a twisting motion.

Original model is then removed from bottom of flexible casing, leaving hollow pattern. Before casting, the mold is turned inside out, like a glove, and lubricated with glycerine.

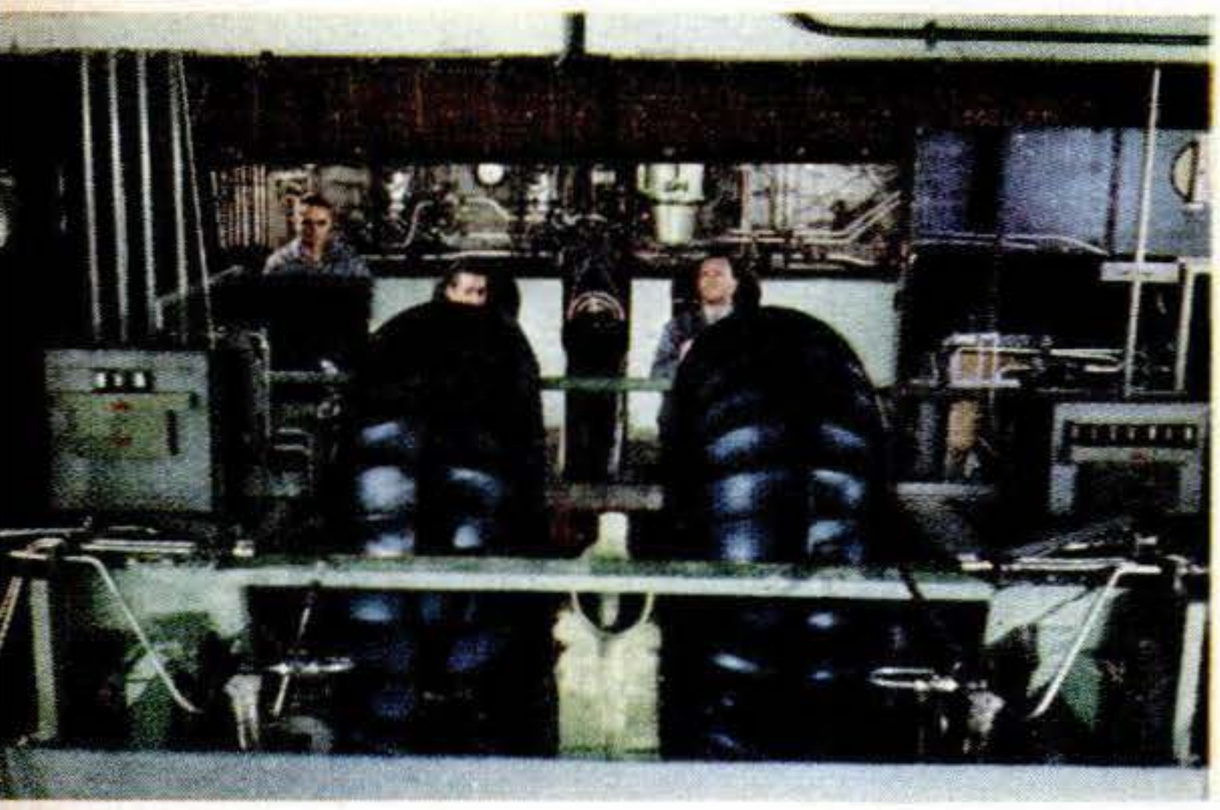
Cast is made from liquid plastic, to which a few drops of a catalyst have been added to make it harden. Casts can also be made of the same materials as mold—latex and Elastex.



Cast sets in 30 minutes, comes out as easily as original model. Figure shown here is made of Plastidur®, which hardens into ivorylike material. It can be colored with cold-dip dye.



Operation of landing gear is simulated on metal silhouette. Below it, red lines show hydraulic pressure system; yellow, return flow.



Giant nose wheels on a Constitution are raised and lowered 20,000 times—just to make sure. Tests simulate actual weight and air resistance.

Flexing Air Giants' Muscles

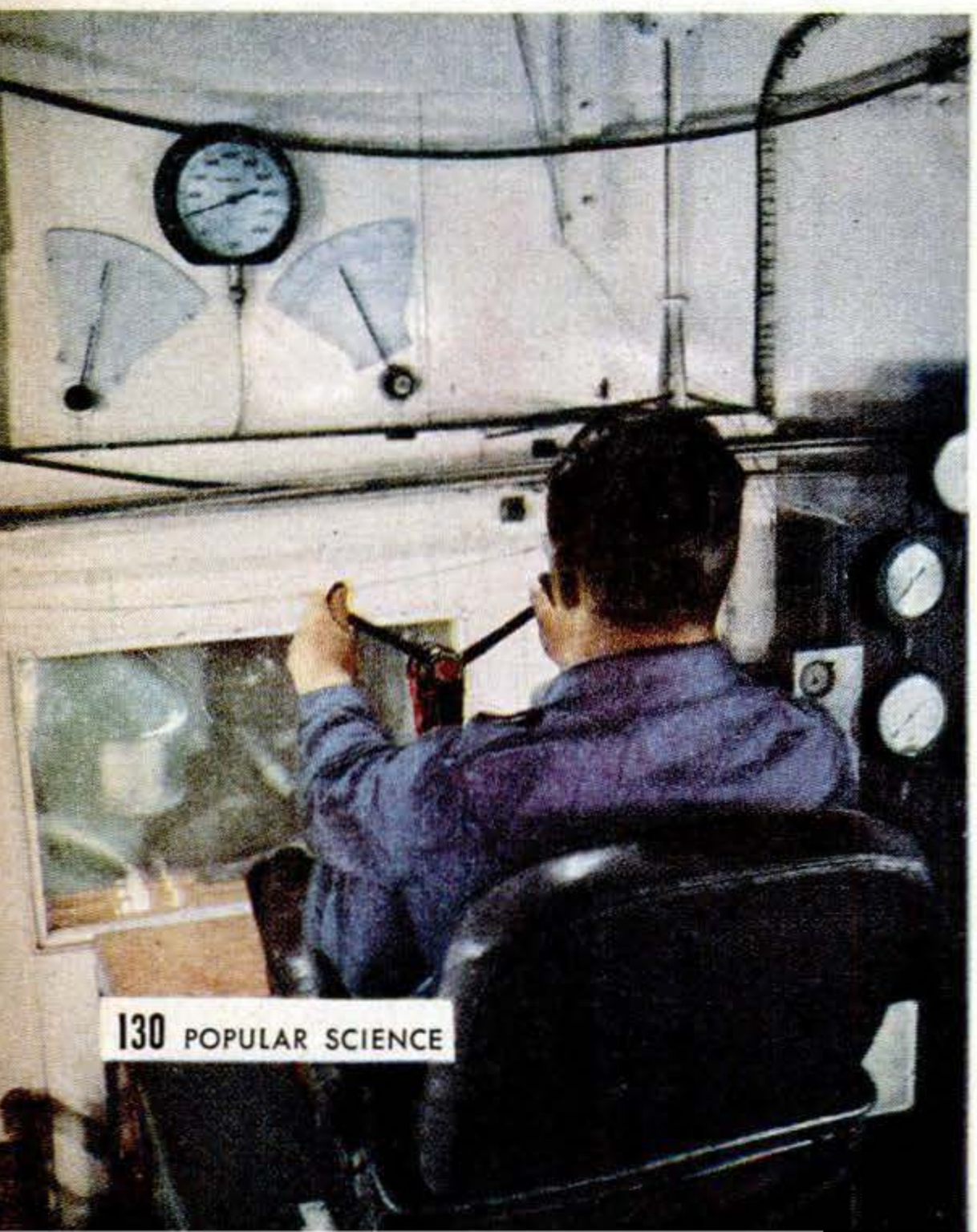
LIKE a fighter flexing his muscles before a battle, giant Constitution Ⓣ transports are getting a chance to try out their "muscles" long before they will actually need them. These "muscles" are the complex hydraulic boosters that move the rudder, elevator, and ailerons and raise and lower the landing gear, multiplying the pilot's force on the controls as much as 45 times.

In Lockheed's California laboratories, the plane's entire hydraulic system is duplicated. First, the metal "nerves" carrying the high-pressure hydraulic fluid are vibrated millions of times to make certain the pipes and fittings will withstand the constant shaking of the plane's engines.

On a sheet-metal silhouette, the electrically operated valves that control the hydraulic boosters are carefully checked and timed. The boosters themselves are placed in a sealed chamber and forced to operate under temperatures that vary from 60° F. below zero to 160° F. above.

Still not satisfied, technicians then run the mechanisms thousands of times until they finally fail. This way, engineers make sure that when something goes wrong, it will happen on the ground—not 20,000 feet up.

Outside temperature chamber, operator sits at plane controls. Pointers show rudder and elevator deflection; gauge, hydraulic pressure.



Inside temperature chamber, technician studies equipment under test. Special suit is inflated with either hot or cold air to protect him.

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Army Tries Water Wings

A MAN-SIZED version of Junior's water wings may soon be coming to the rescue of paratroopers downed at sea. Being tested by the Army, the wings fit under the arms (inset) and will support 300 pounds of man and equipment, keeping the wearer's head well above water. Deflated, they fold flat under the armpits, out of the way of the parachute harness. Each is inflated from its own small cylinder of compressed air.

Tractor Does New Jobs

DRIVE a Ford tractor under a frame of bent tubing, fasten six bolts—and you have the power shovel shown at right. The frame, designed to increase the versatility of farm tractors, was demonstrated recently by Dearborn Motors at Clarkston, Mich. With various attachments, it enables a tractor to excavate and move dirt, stack baled hay, load manure, shovel grain into a bin, or clear away snowdrifts.

Youthful model assembler gets set to launch 9-inch, gas-propelled rocket along guide wire.

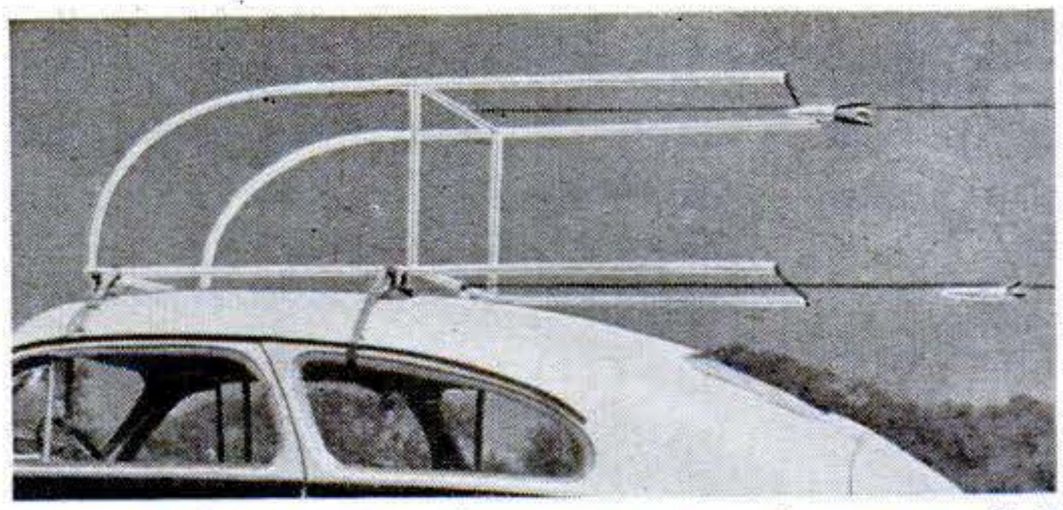
Rockets on Wires Hit 125 m.p.h.

TOYS, too, have entered the era of jet-propelled flight. Just like the real thing, the 9-inch rocket pictured above is powered by the thrust of compressed gas escaping from its tail.

In flight, the midget missile shoots along a guide wire for 200 to 1,000 feet at speeds up to 125 m.p.h. The propellant is non-burning carbon dioxide, which comes in cartridges like those used to charge soda-water bottles.

The rocket and a similar jet airplane, made of balsa wood, are sold unassembled and unpainted by Victor Stanzel & Co., of Schulenburg, Tex.

Rocket is set off by puncturing cartridge of carbon dioxide in tail with pointed plunger of "jet gun." Large hole, letting gas out fast, gives high speed; small hole, longer flight.



Rocket beats jet plane in race along parallel wires to frame of tubing mounted on car. They stop without damage when arresting hooks catch on rubber bands stretched across ends of frame.

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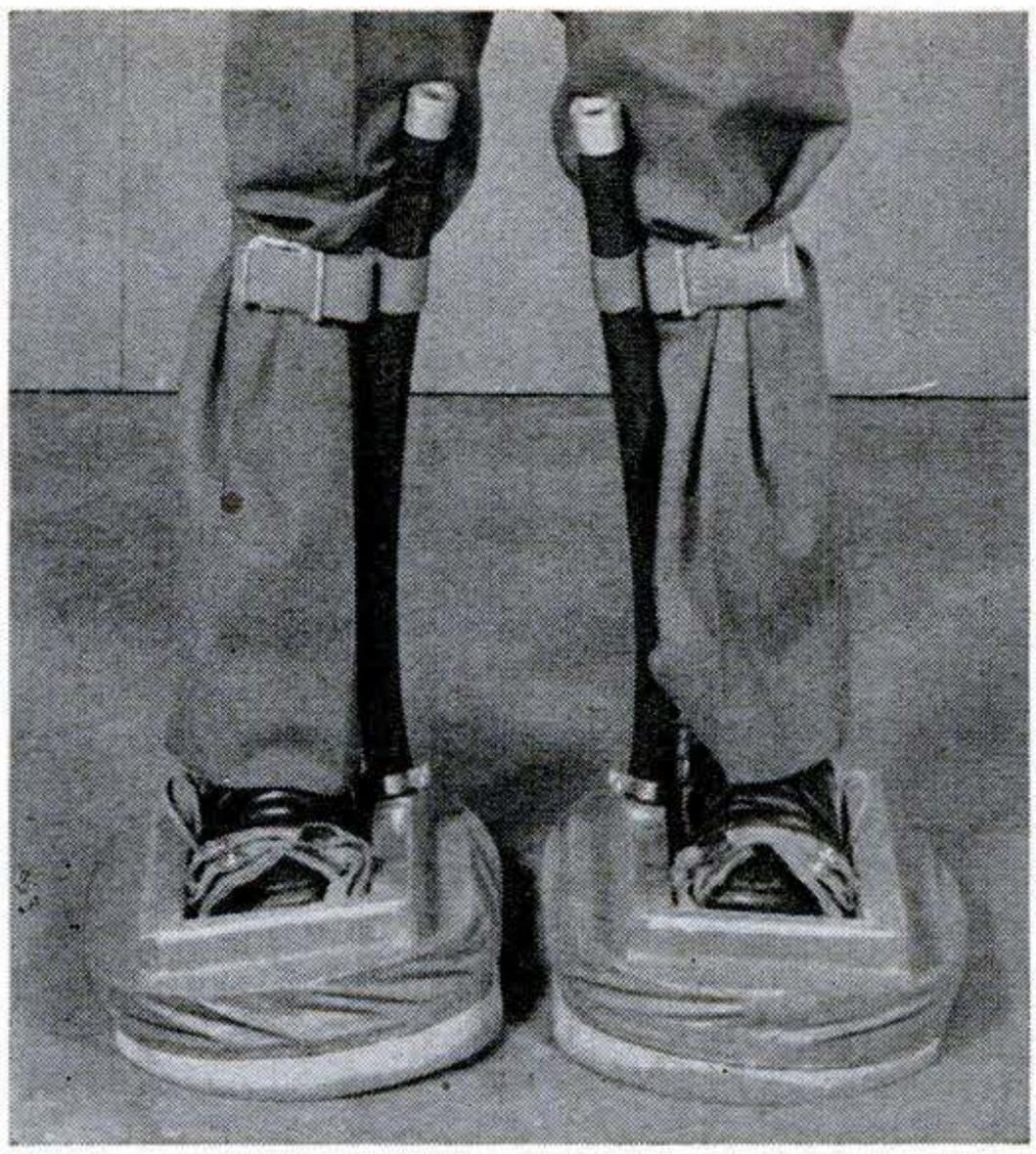
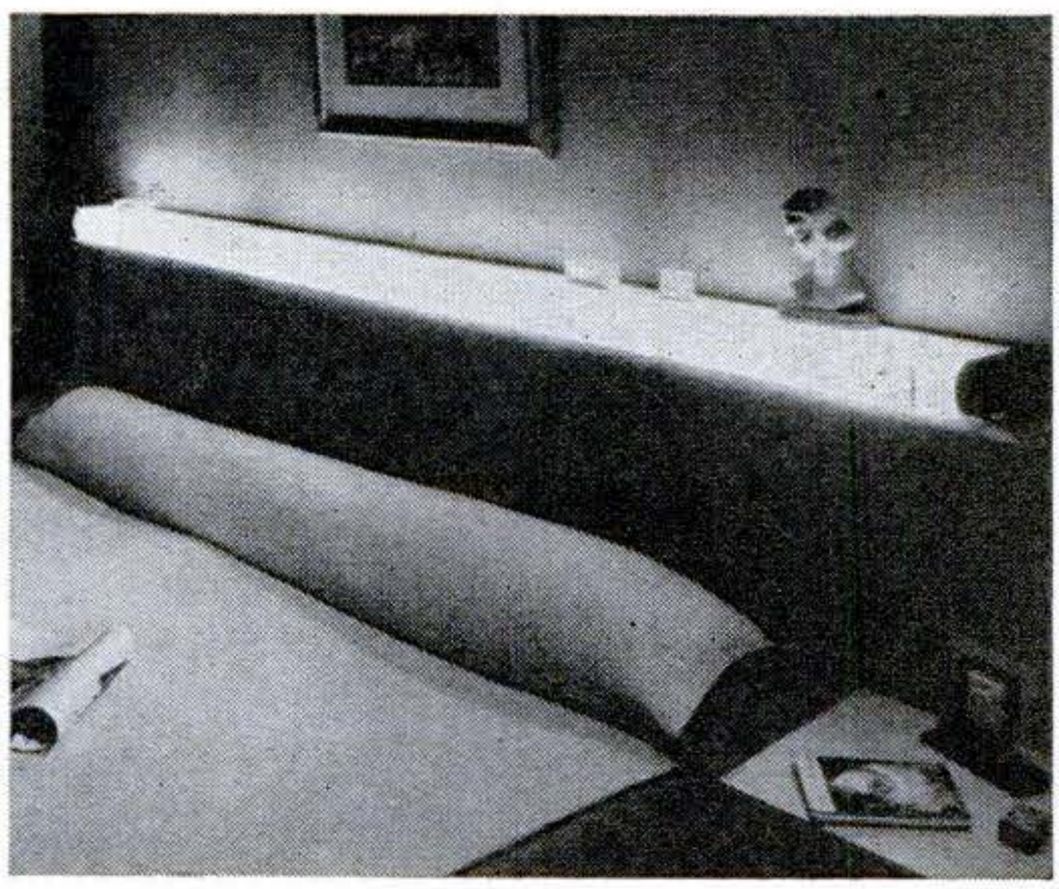


Soft Shoes Save Soldiers

A SOLDIER wearing these sponge-rubber "snowshoes" to lighten his step has a 95-percent chance of crossing a mine field safely. Army engineers developed the new footgear at Ft. Belvoir, Va. Coverings of watertight fabric over their upper layers and rubber hoses strapped to the wearer's legs let the sponge-rubber pads "breathe" for resiliency when used to walk in water.

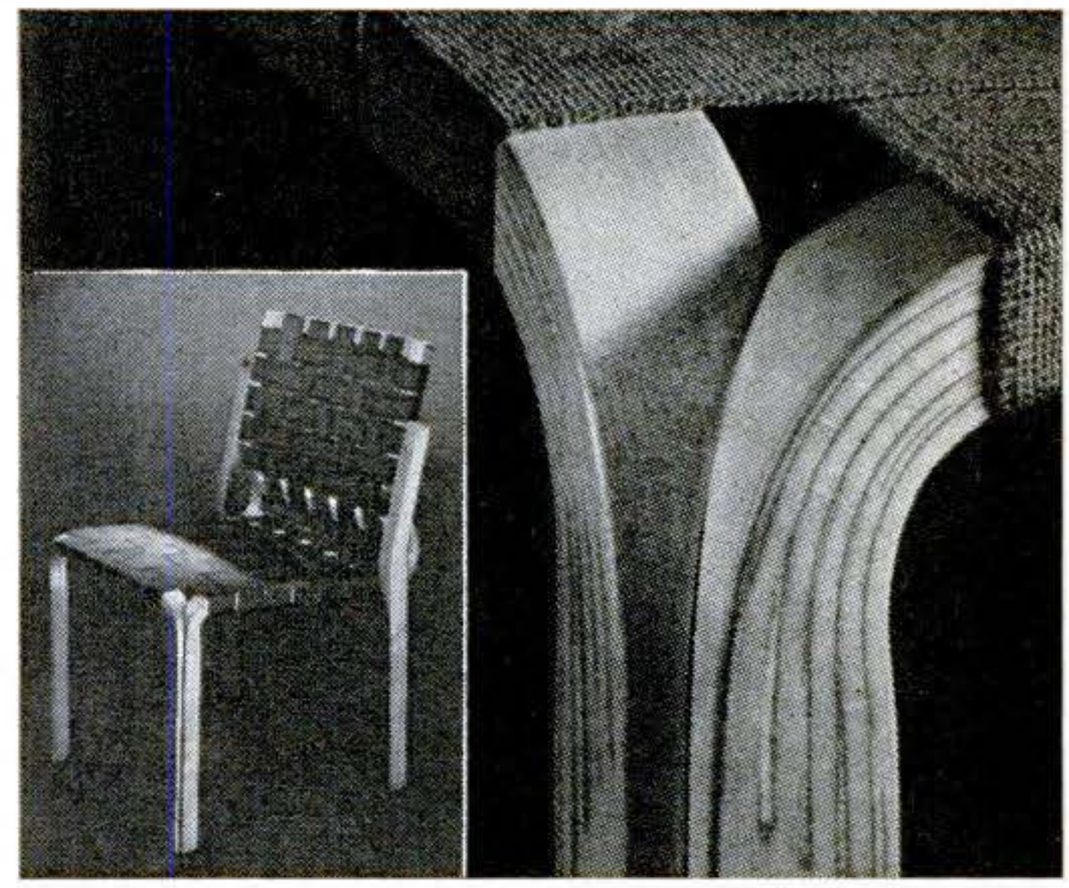
Ladder Weighs 8 Pounds

THOUGH easily lifted by a child, as you can see, this 8-pound ladder will support 1,000 pounds of working load. Its strength comes from the girder shape of the legs. The Featherweight®, 10 feet tall, is entirely aluminum, except for rubber pads on the feet, steps, and shelf. Made by Bardwell and McAlister, of Burbank, Calif., the ladder sells for about $11.50.



Bed Light Does Two Jobs

A NEW 10-foot Sylvania lighting unit, shielded at top and front by translucent plastic, provides both indirect illumination and direct light for reading in bed. Downward refraction of light by the plastic yields 15 foot-candles at book level. Separate switches control one 40-watt and two 20-watt fluorescent lamps, set end to end.



'Y' Strengthens Chair

STRIPS of laminated wood, serving as the frame of this new chair, are bent downward at the front corners and joined to form its front legs. This "Y" joint, shown in close-up, is said to double their strength by distributing the strain evenly in two directions. The chair was designed by Alvar Aalto, a Finnish architect now in the United States.

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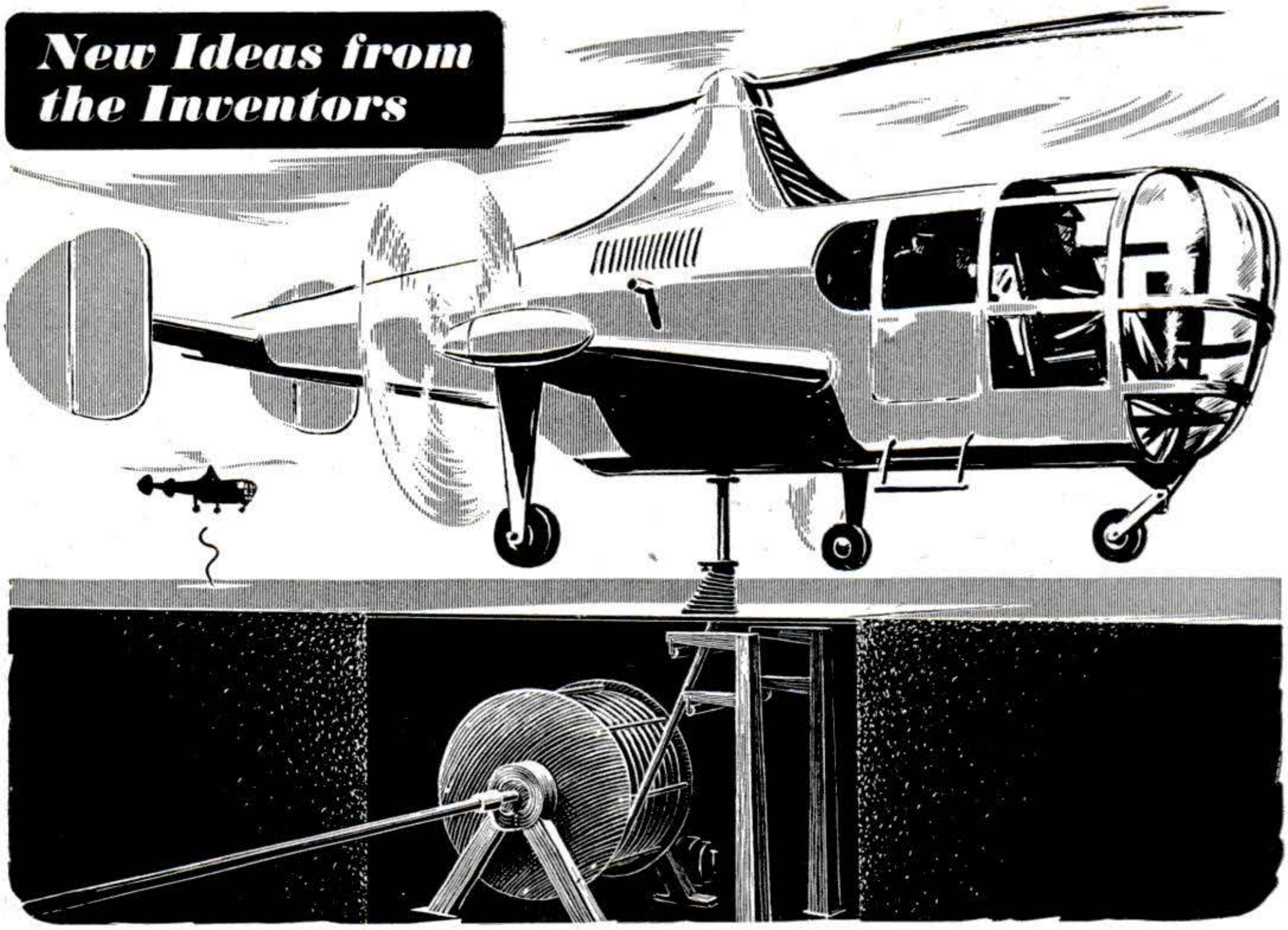
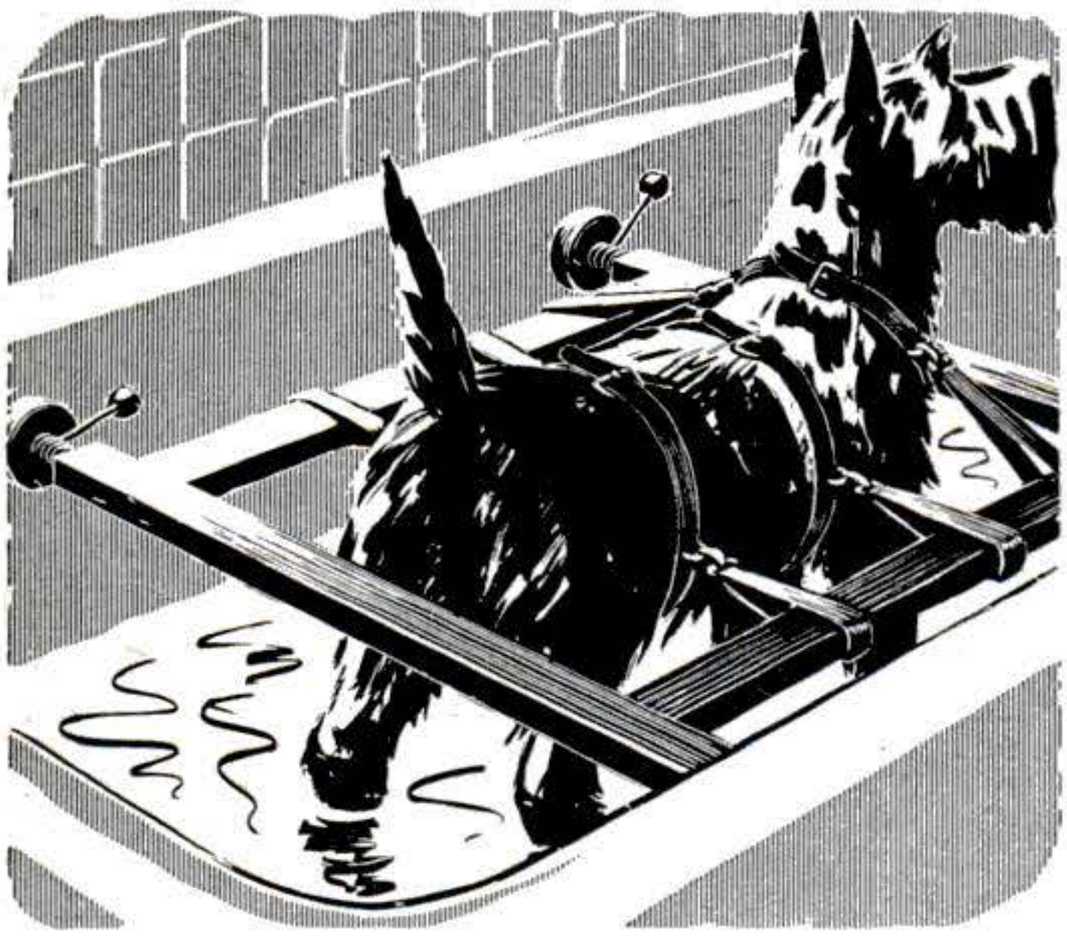
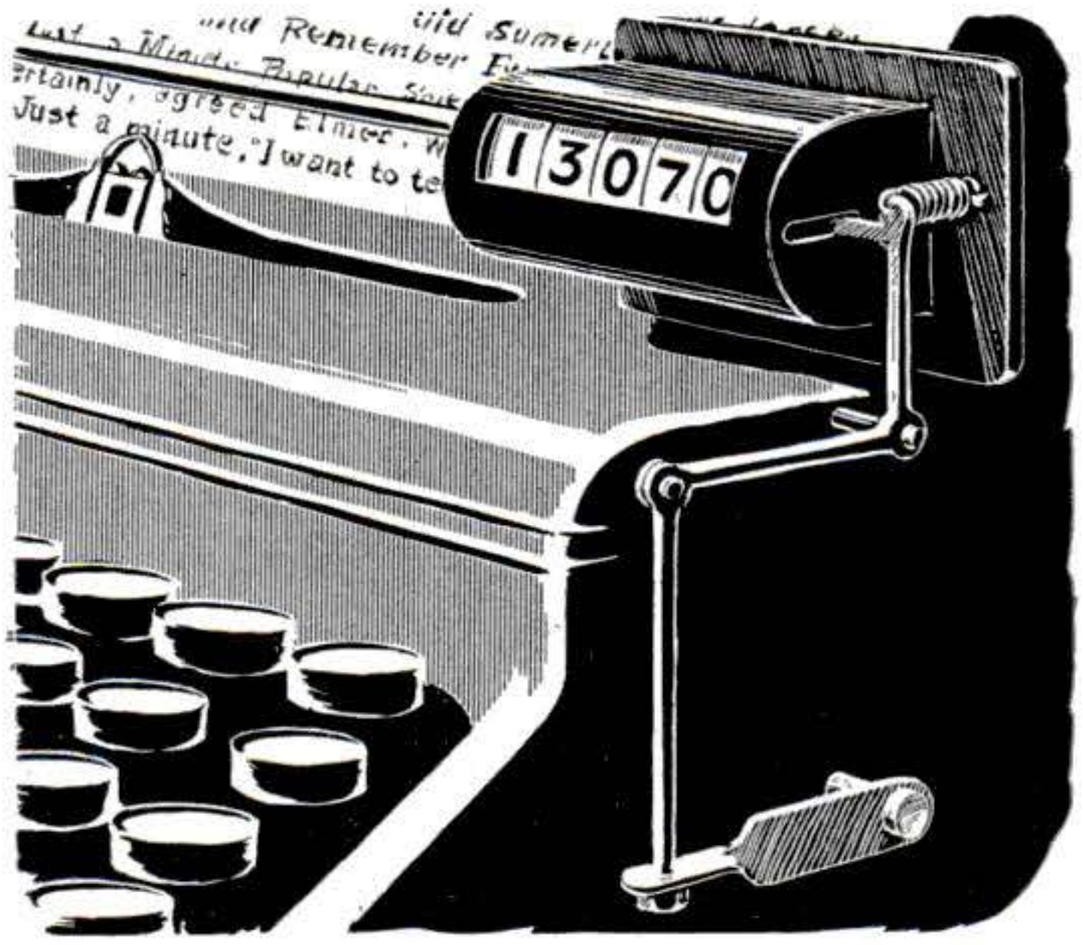
New Ideas from the Inventors



Autogyros Get a Lift. With this take-off device invented by H. F. Pitcairn, of Bryn Athyn, Pa., autogyros with unpowered rotors could take off straight up the way helicopters do. Compressed air, piped into the plane through a flexible hose, jets out through nozzles in the rotor, spinning the blades. As the plane rises, an underground reel pays out the hose. Once aloft, the plane drops the hose and flies off.



Bathing Harness Holds Dogs. If your dog-bathing sessions end up with more water on you than the dog, you'll probably go for this invention of F. L. Short, of New York City. It's a frame that fits inside the bathtub and holds the dog firmly in place with cross straps. Adjustable, rubber-tipped screws make it fit tightly in any tub.



Typewriter Counts Words. For writers who must write to an exact length, C. W. Lamb, of Inskip, Tenn., has patented a word counter for typewriters. It chalks up a word the first time the space bar is hit after each word. It then disconnects and is reset only when another letter key is hit. Thus extra spaces do not register as words.

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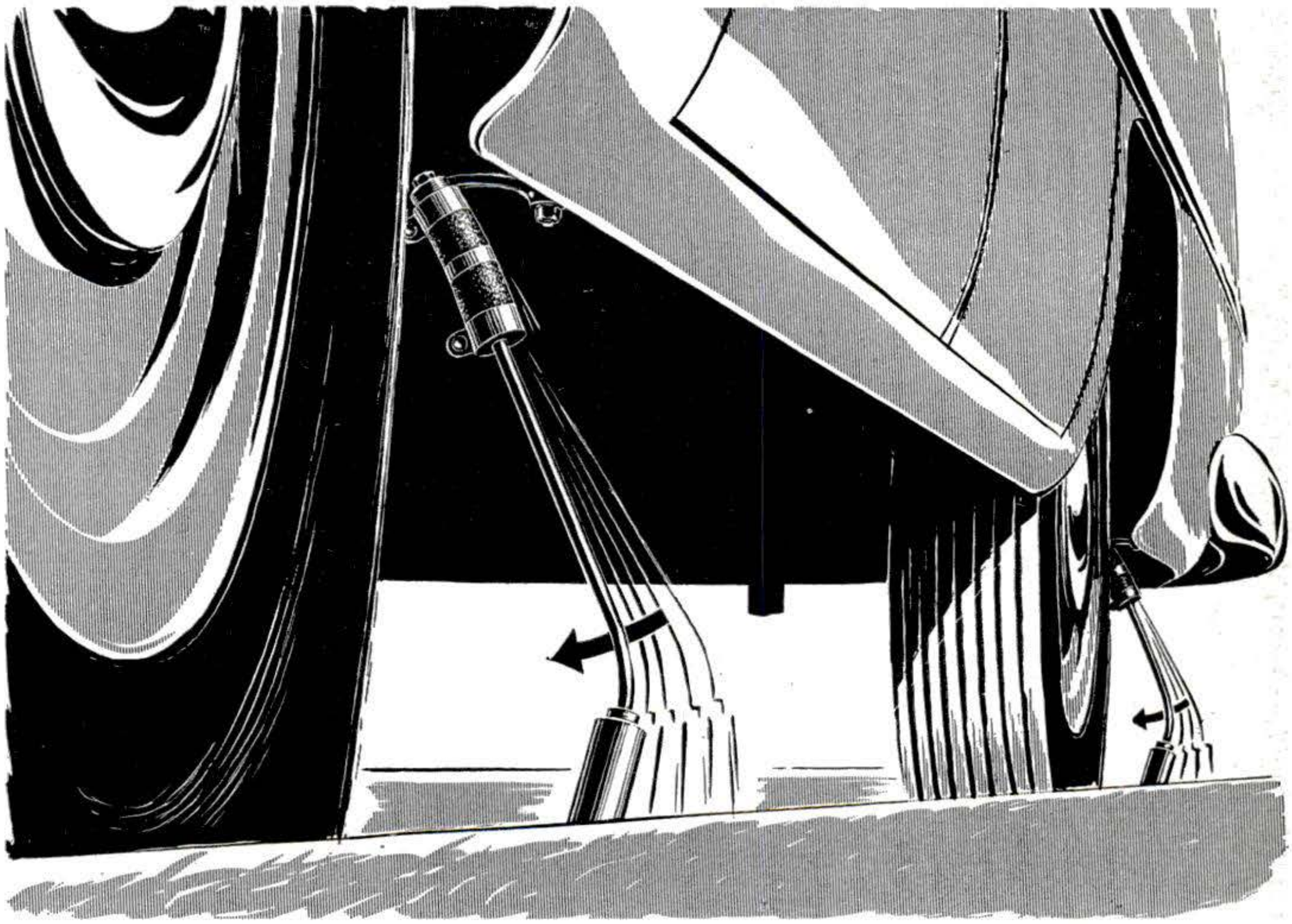
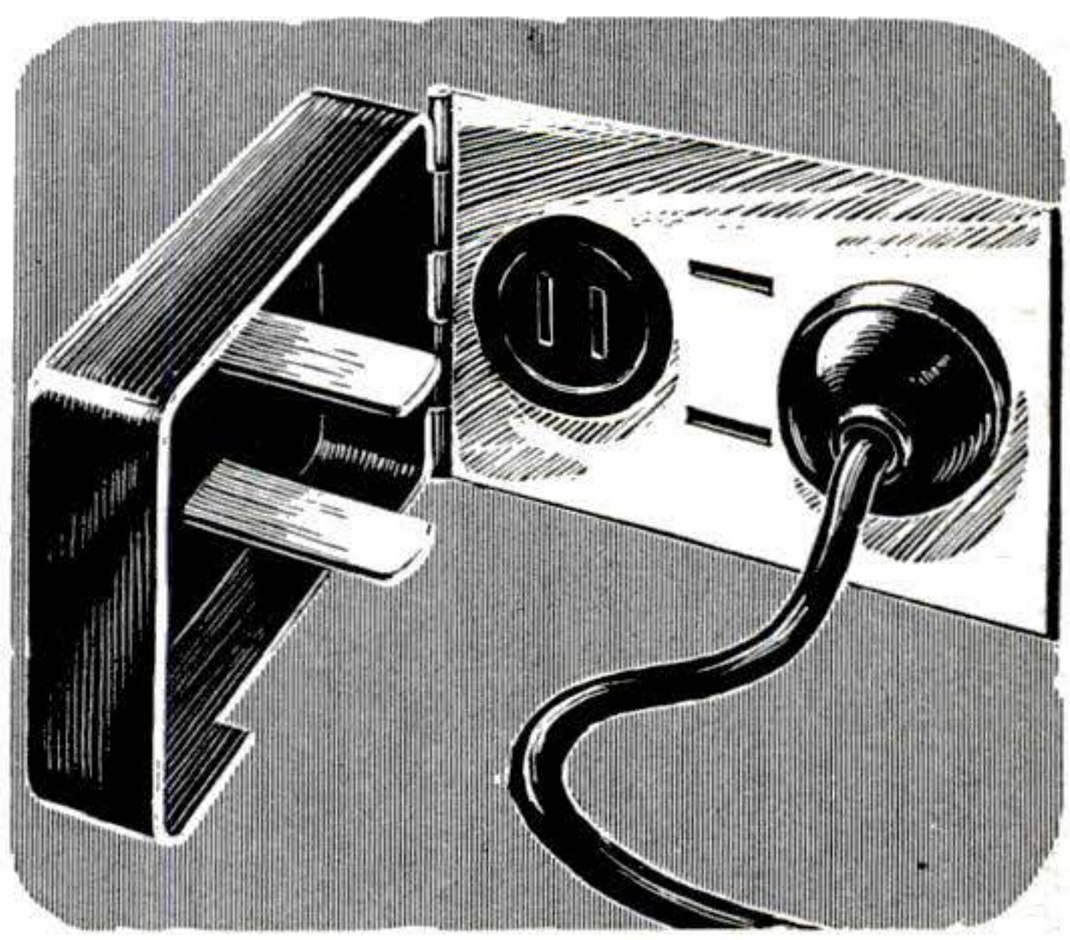


Curb "Feelers" Save Tires. You won't scrape your tires when you drive up to a curb with these "feelers" invented by E. Sines, of Toledo, O. Extending slightly beyond the fenders, the flexibly mounted, roller-tipped arms touch the curb first and are pressed inward as the car moves closer. This closes a switch, flashing lights on the car's dashboard to warn the driver that a curb, wall, or other obstruction is near.

Picker Speeds Berrying. There'd be no bending over or one-handed picking with this berry-picking aid patented by R. E. Faulkner, of Chicago. As fast as the berries can be picked, they are dropped into curved cups strapped on the picker's wrists, and flexible tubes carry them down to a pail on a harness around the picker's waist.



Sockets Are Shockproof. Even if Junior managed to open this safety cover for electrical outlets, he still couldn't get a shock. As the hinged cover opens, its two prongs are pulled out of a socket between the outlets. This cuts off the current until the cover is again closed. It was invented by H. A. Abraham, of Philadelphia.

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Overhead view shows seating arrangement in proposed all-wing airliner. Forty passengers in center cabin and the lounges on both sides of it might look out through windows built into floor.

In forward-vista cabin (below), under pilots' and engineer's compartment, 30 passengers would see ahead through transparent plastic reinforced to form the leading edge of the wing at its nose.

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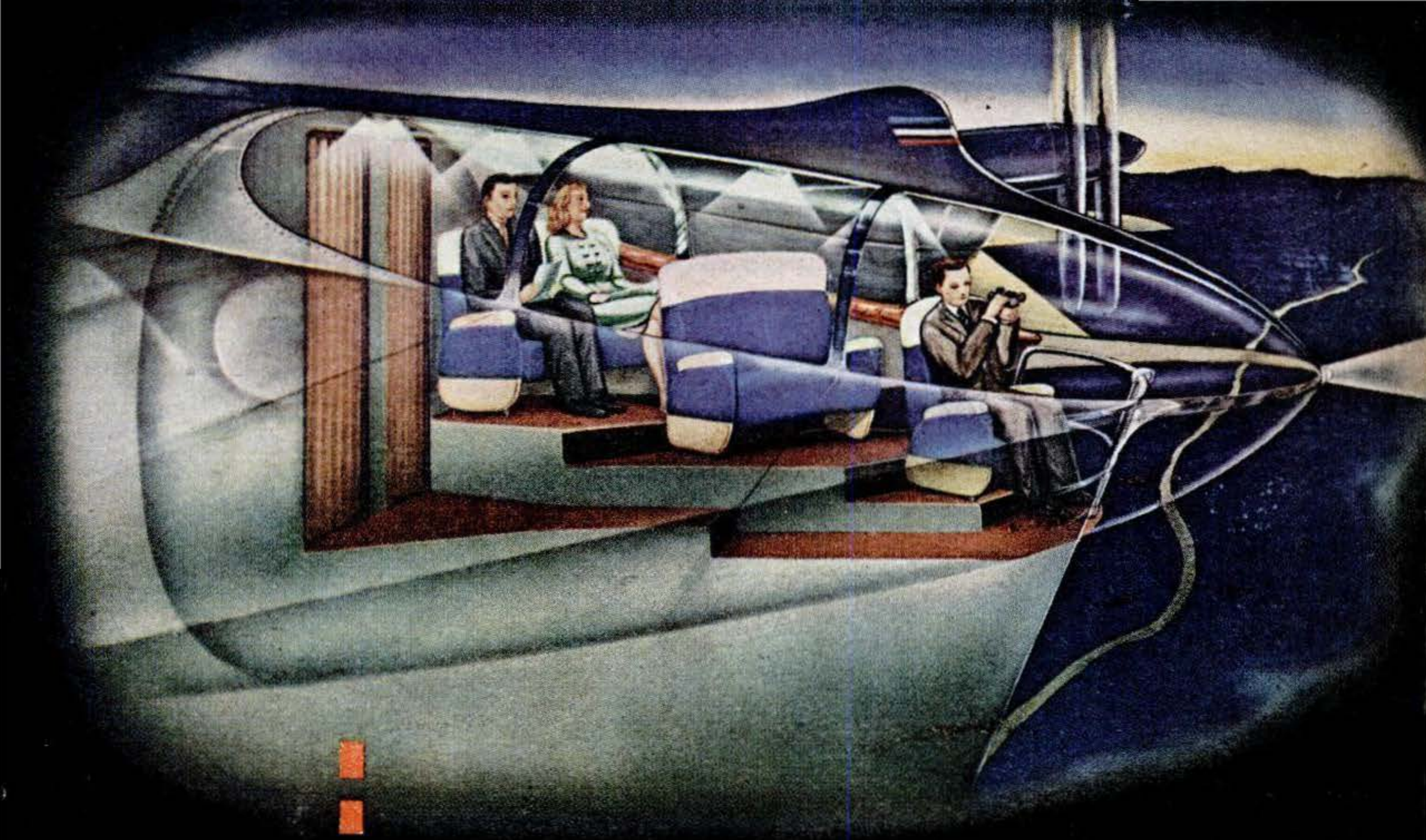
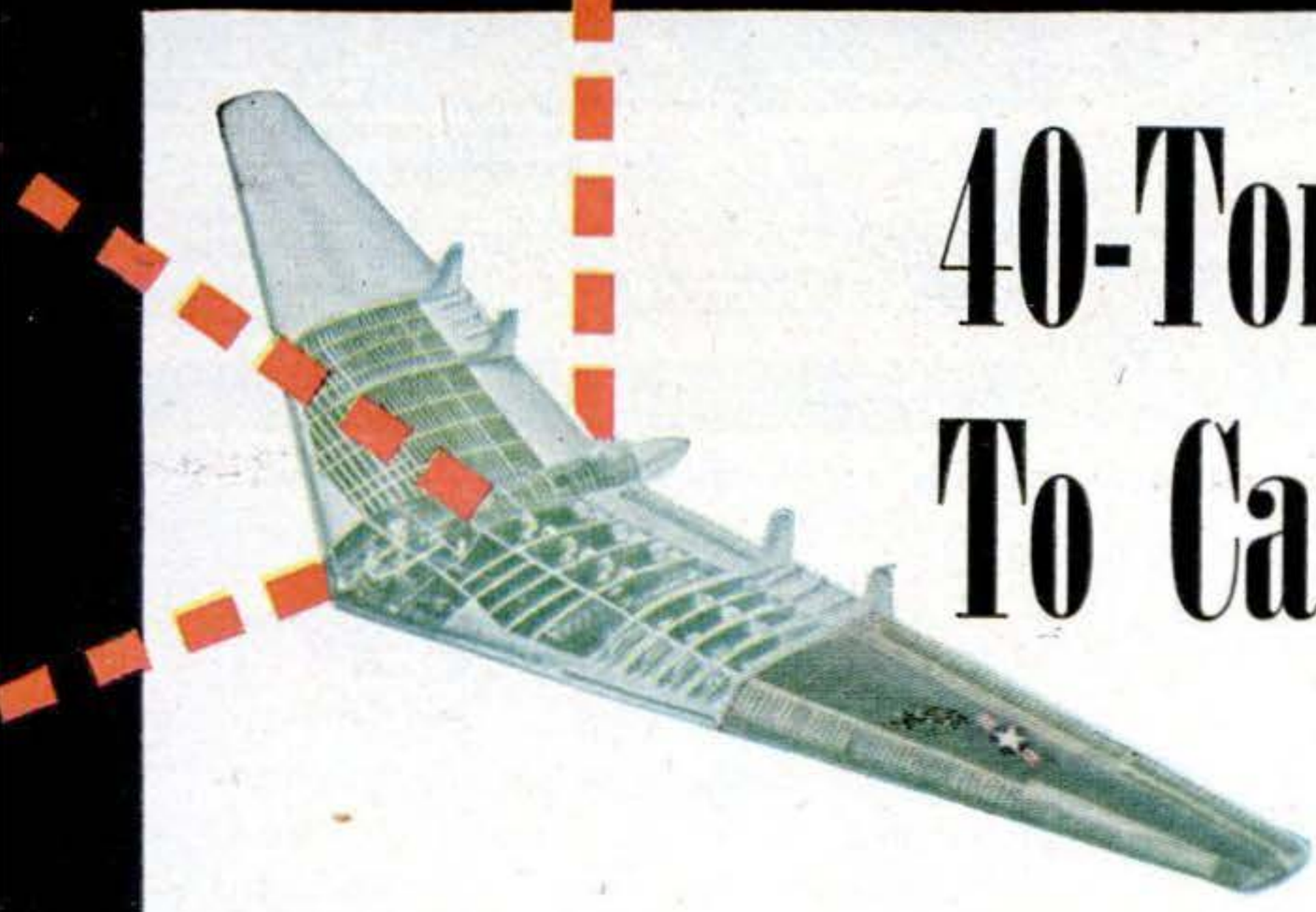


Tail cone, in place of the pointed blister in bomber versions of the flying wing, would carry 10 passengers facing backward in three tiers of seats with views to rear, both sides, and overhead.



40-Ton Flying Wing To Carry 80 People

THE MAN who designed the flying-wing bomber has now completed plans for an air liner of the same size and shape.

These drawings show how designer Jack Northrup sees it: a 172-foot wing that would stand 15 feet high and weigh 40 tons empty. Eighty passengers would ride in it, 100 m.p.h. faster—he figures—than in conventional air liners of the same weight and power.

Though Northrup has no plans for producing it soon, the all-wing air liner is no mere drawing-board fantasy. Behind it lie test flights of its prototype, his XB-35, and that bomber's jet-driven sister, the YB-49. It would differ from them mainly in having passenger cabins where they are rigged to carry bombs. Like the bombers, the air liner would have no tail. Trailing edges of the wing would serve as combination elevators and ailerons. Vertical air separators would increase directional stability.

The flying-wing liner could be driven by jet engines—as shown here—or propellers.

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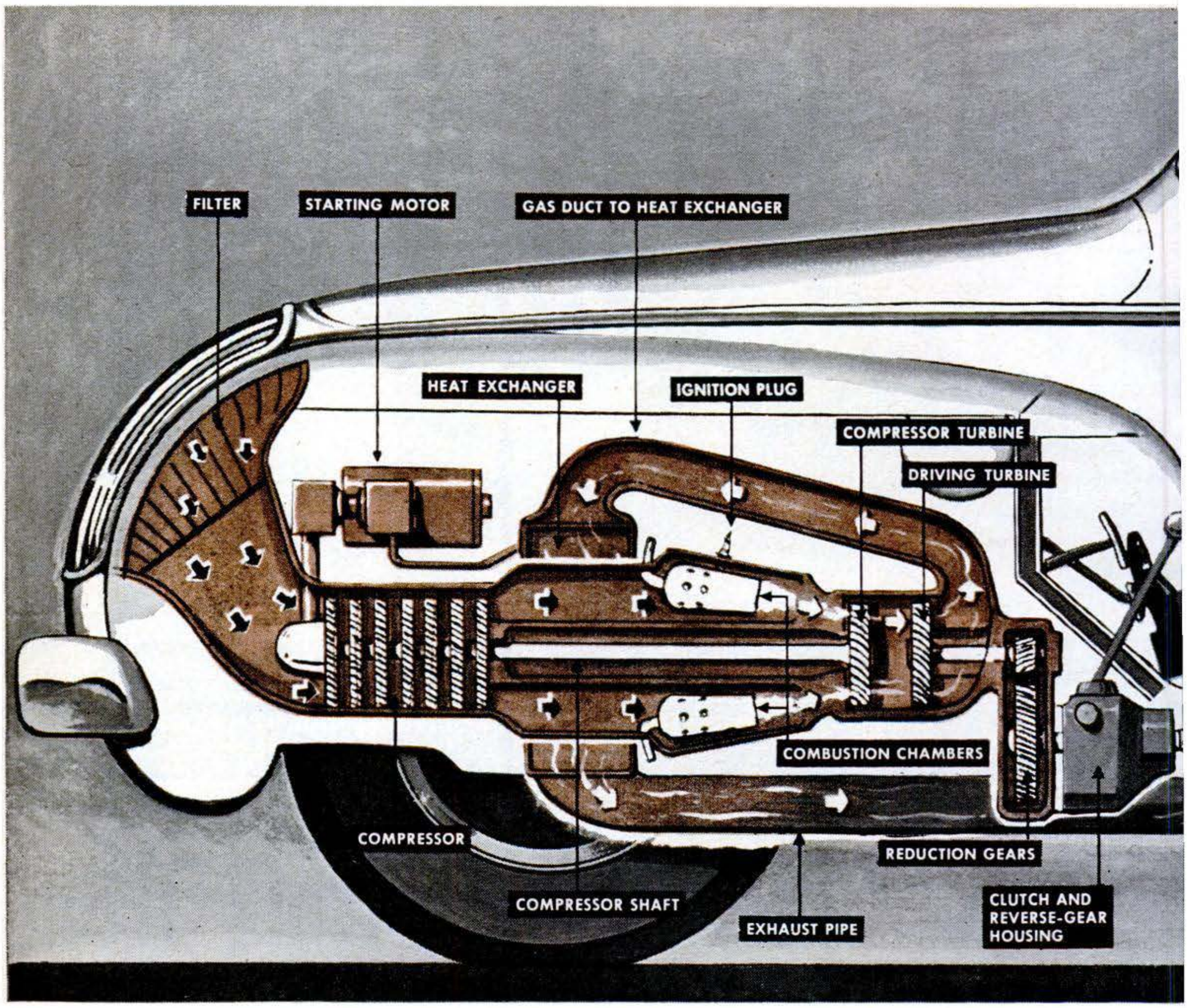

Gas from combustion chambers rotates separate turbines for air compressor and drive shaft.

Turbine Designed for a Car

A NEW era in motoring was foreshadowed by the exhibition recently in Birmingham, England, of the first gas-turbine engine designed for automobiles.

Still in the early stages of development, the new turbine (PS, Aug. '48, p. 154) weighs about a third as much as a piston engine of the same power. And it will burn, as one of its designers put it, almost any kind of oil "from kerosene to old candle ends." Main disadvantage: high fuel consumption.

Basically, the gas turbine for automobiles is a small version of those now used in high-speed combat airplanes. The drawing at the top of this page, based on sketches published by the *London Illustrated News*, shows how it would work in a car.

A compressor, turned by an electric motor for starting, sucks air from the atmosphere through a filter and blows it into combustion chambers. There a spray of fuel oil mixes with the compressed air and, once set afire by an ignition plug, burns fiercely.

Flaming gas, escaping from the combustion chambers, rotates two turbines. The first turns the air compressor; the second, on a separate shaft, is geared to the car's rear wheels.

The partly cooled gas then goes back to a compartment called a heat exchanger, where—on its way out—it preheats incoming air. This not only steps up the engine's fuel-burning efficiency, but helps to muffle its jetlike exhaust.

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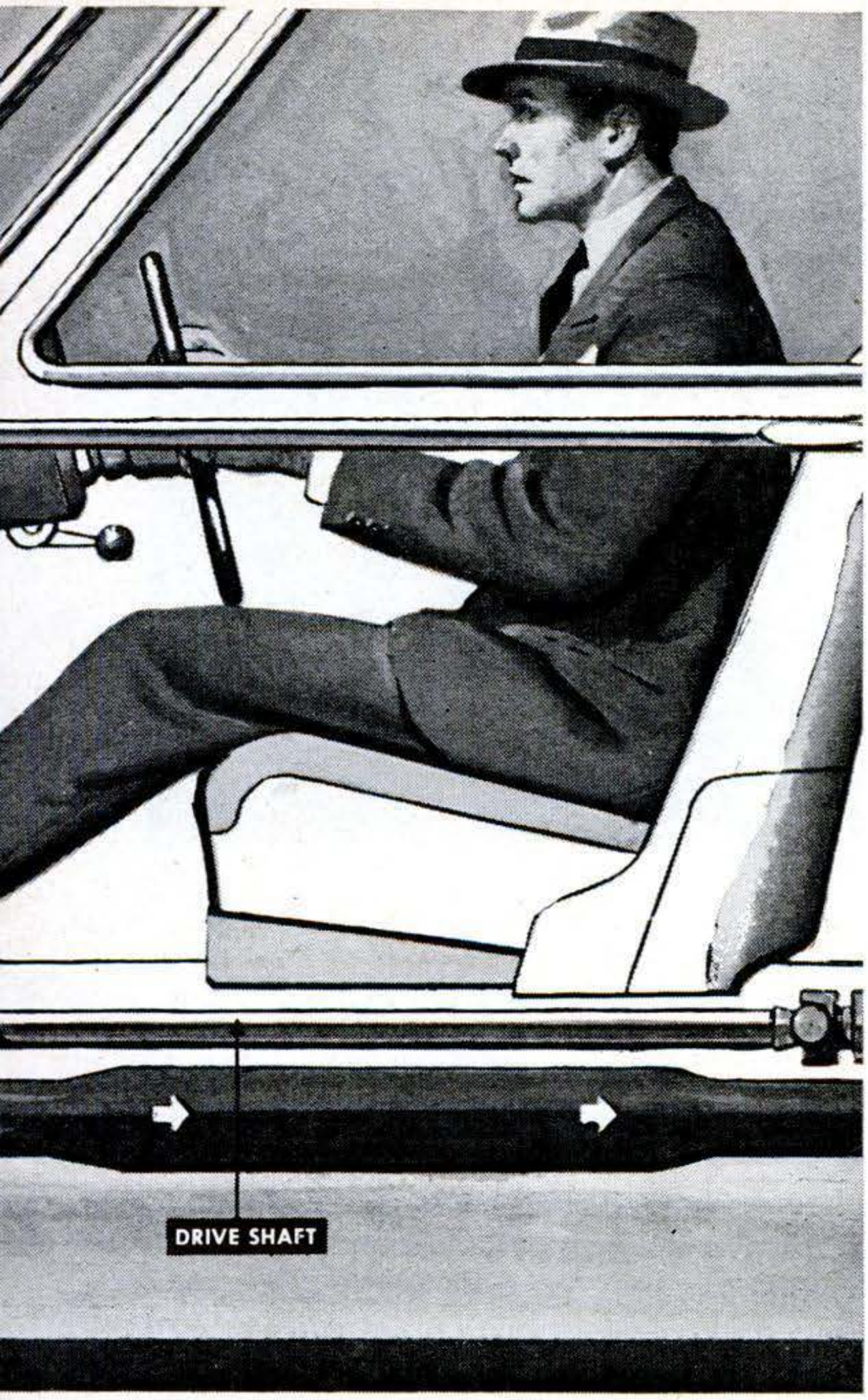
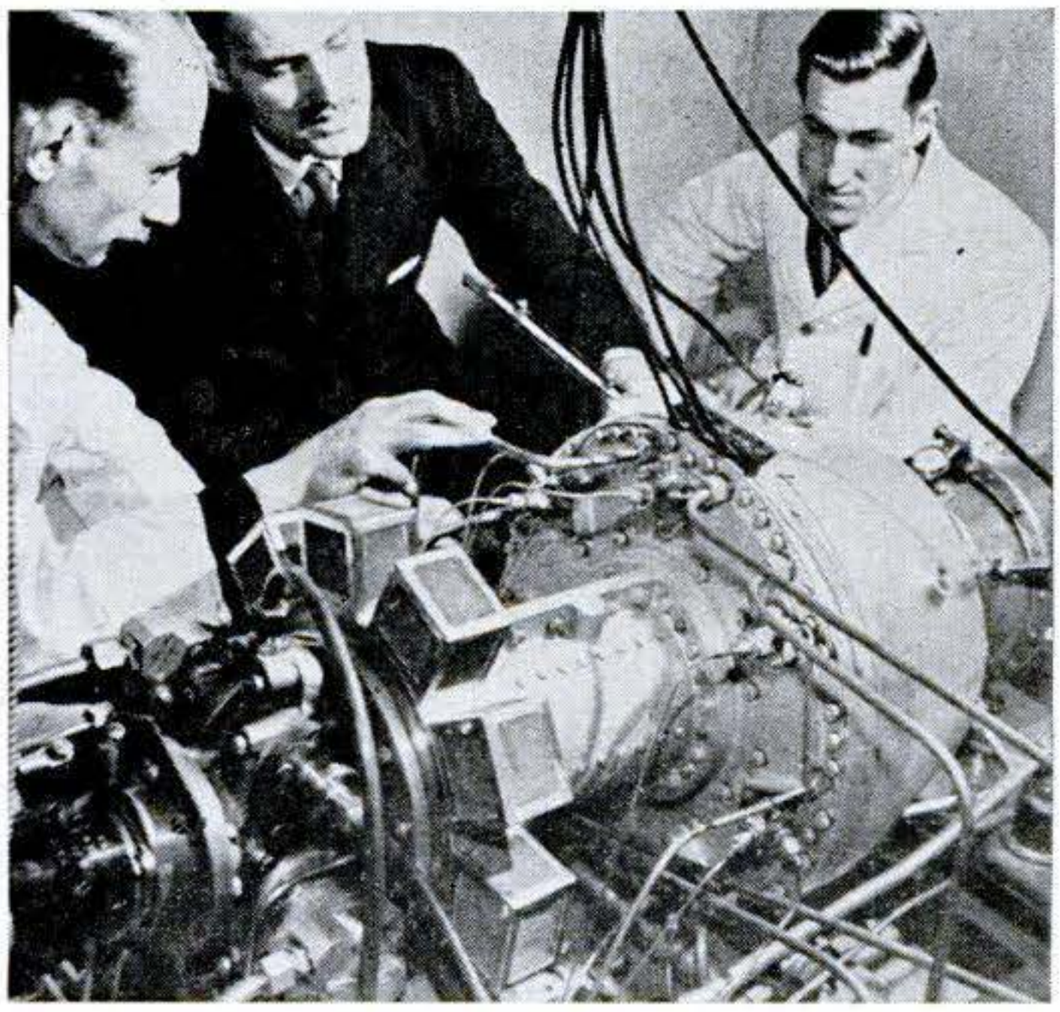


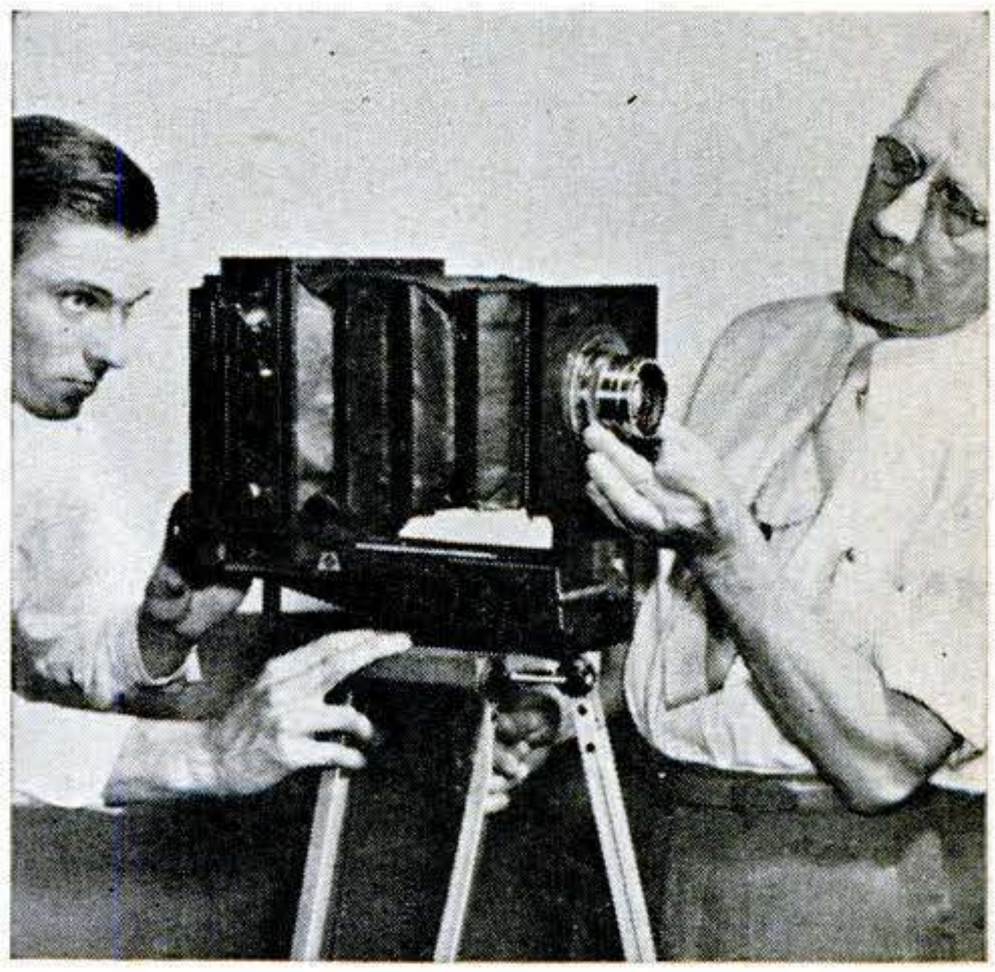
Black arrows show air flow; white arrows, gas.



British gas turbine for automobiles, shown with its inventors, weighs only 300 pounds but develops 160 hp. It's about three feet long and has a maximum diameter of 15 inches.

Baby Jet Drives Bike

JET manufacturers are losing no time in developing peacetime models for the public's use. First on the market is a baby pulse jet that weighs only 8¾ pounds yet develops a static thrust of 30 pounds—enough to send the motorbike above zooming along at better than 70 m.p.h. Called the D5-1, it burns ordinary gasoline and is started by a coil vibrator and compressed air. It is made by the Aeromarine Co., of Vandalia, Ohio.



Camera Tests Lenses

YOU won't find this camera out at the beach this summer snapping candids, but because of it, your own cameras will be getting better. Developed by Bausch and Lomb, it's interested only in testing new lenses for other cameras. For the utmost in precision, film plane and lens board can be kept parallel to within 5/10,000 of an inch. A micrometer affords similar accuracy in focusing, while a built-in microscope permits even finer focusing.

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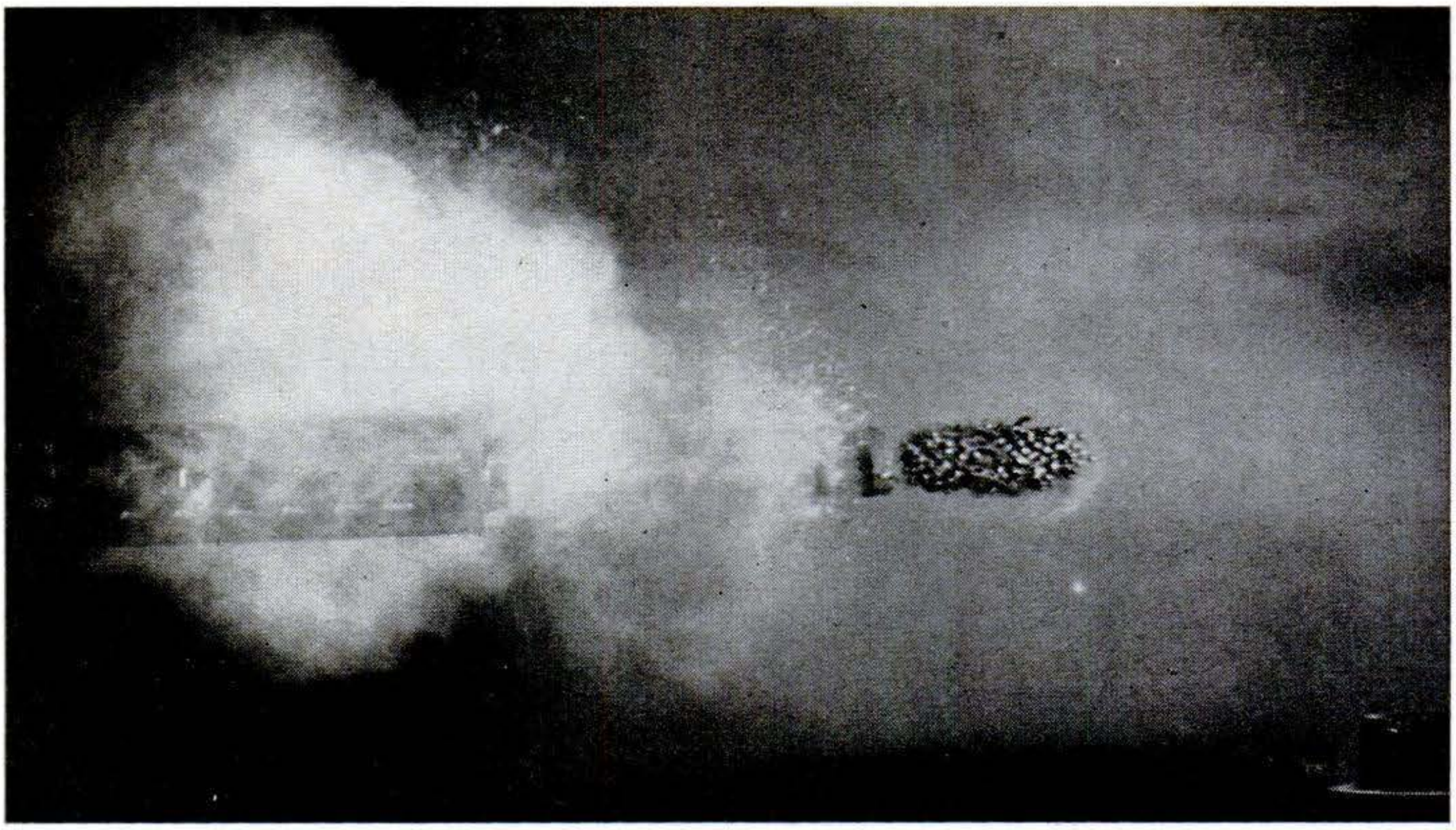


Charge of shot, traveling 1,400 ft. a second, is photographed 4 in. from gun's choke-tube extension. Vents in tube let out gases that otherwise would cloud camera's view of the pellets.

Camera Snaps Flying Shot

AT THE top of this page is a portrait of lead pellets leaving a shotgun at 954 m.p.h. They were snapped by an ordinary Speed Graphic Ⓣ camera in the studio of E. Baden Powell at Pasadena, Calif.

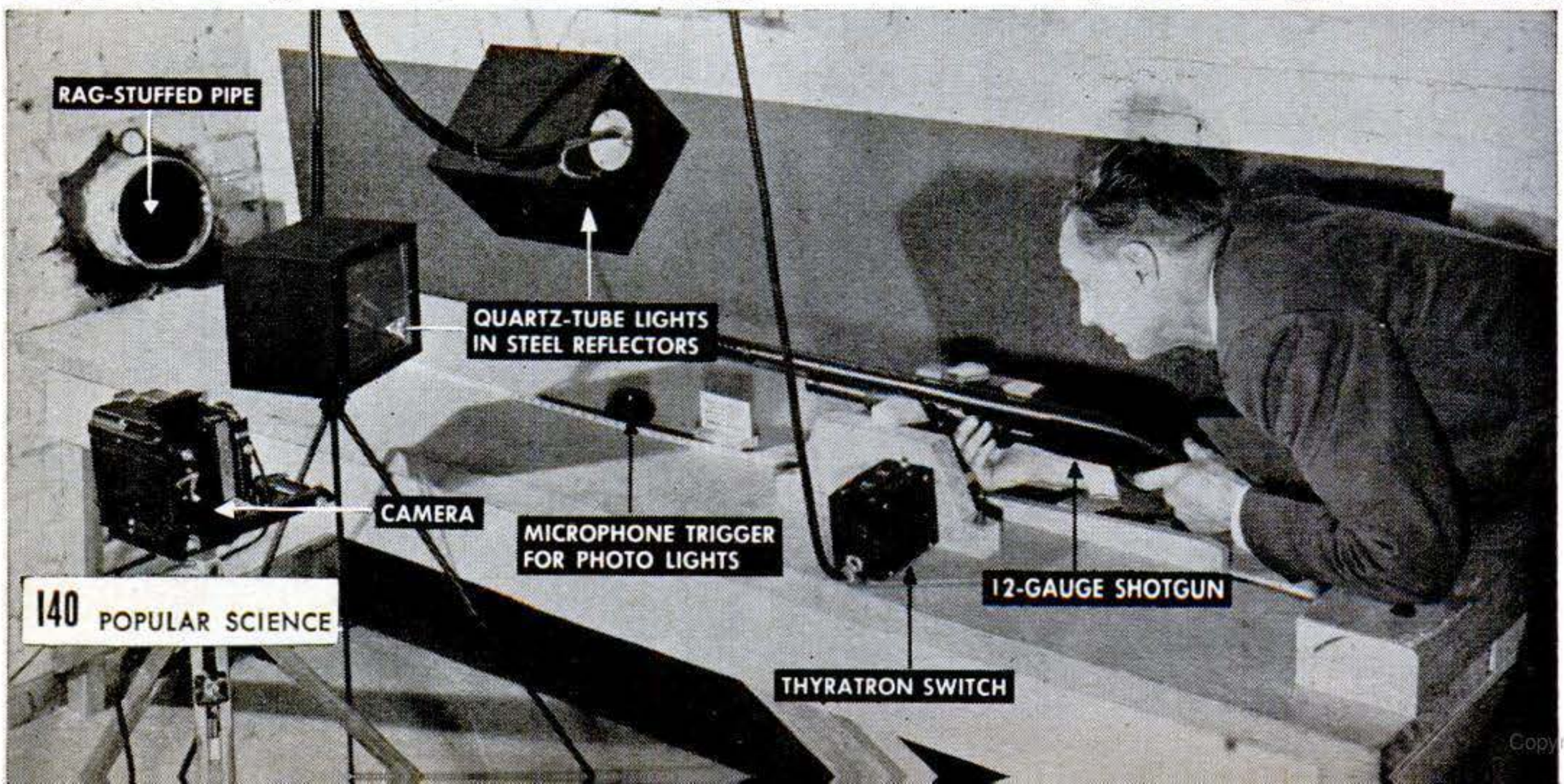
The secret? It's in the lighting, a flash 1,000 times brighter than outdoor sunlight. The source is two pencil-shaped quartz tubes, filled with xenon gas, that light up and black out in 3/1,000,000 of a second.

It takes 28,800,000 watts to flash the tubes. A series of multipliers builds up these baby lightning bolts from house current and stores them in condensers. They are released when a switch is tripped by sound from a gun's blast striking a microphone.

The switch is a gas-filled electronic tube, called a thyratron. It works like a valve, letting current through when it receives the microphone's signal and then quickly shutting it off as the current "pressure" drops. The mike's distance from the gun determines at what point the shot is photographed.

Powell uses this camera setup to test his POWer-PAC Ⓣ, a shotgun muzzle attachment to control the pattern of shot.

To take pictures like one at top of this page, room lights are turned off and camera shutter is opened. Shotgun is then fired into target of rags in end of pipe. Microphone near muzzle trips camera lights when it "hears" blast. Duration of their flash is length of exposure.



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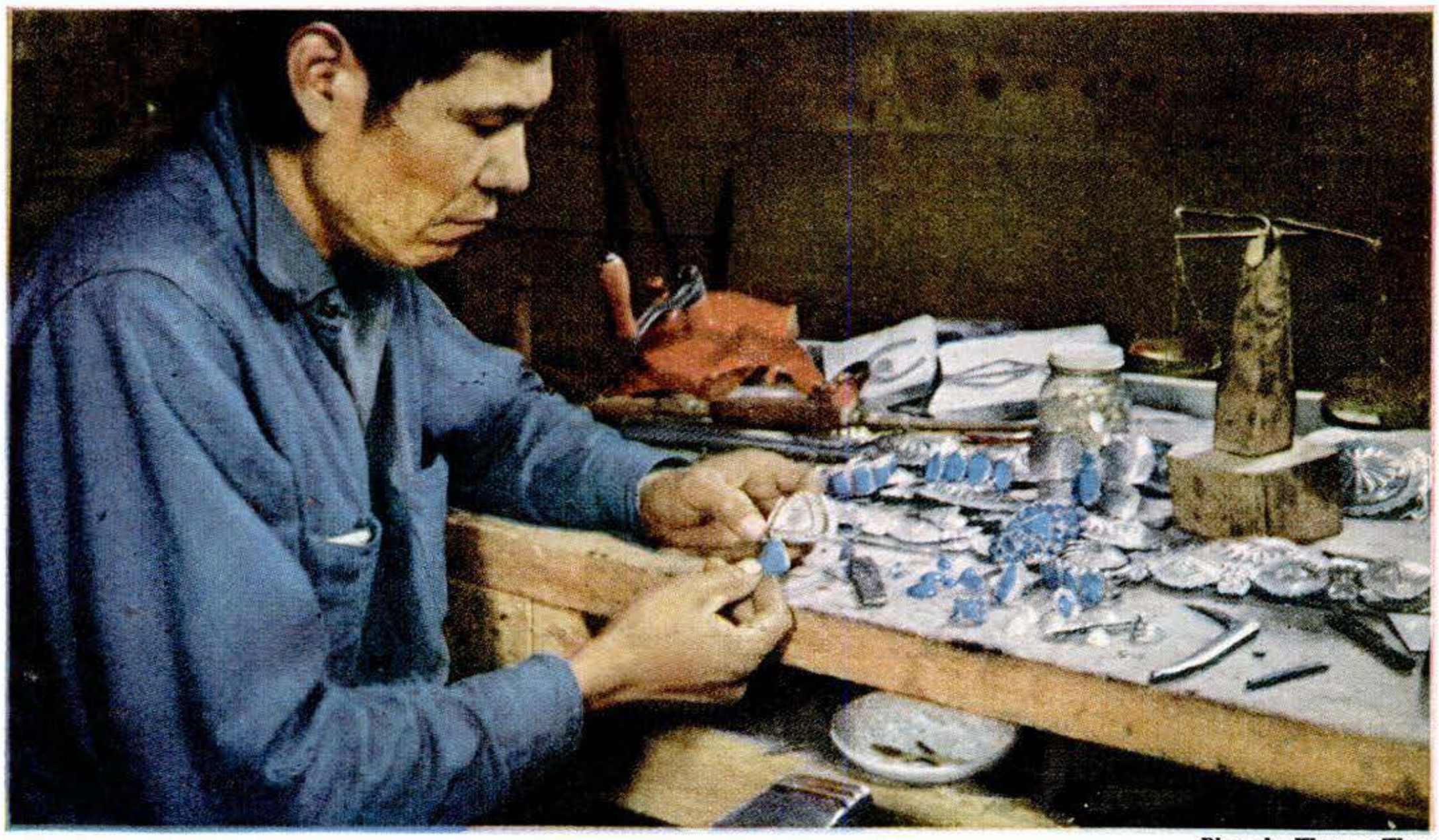
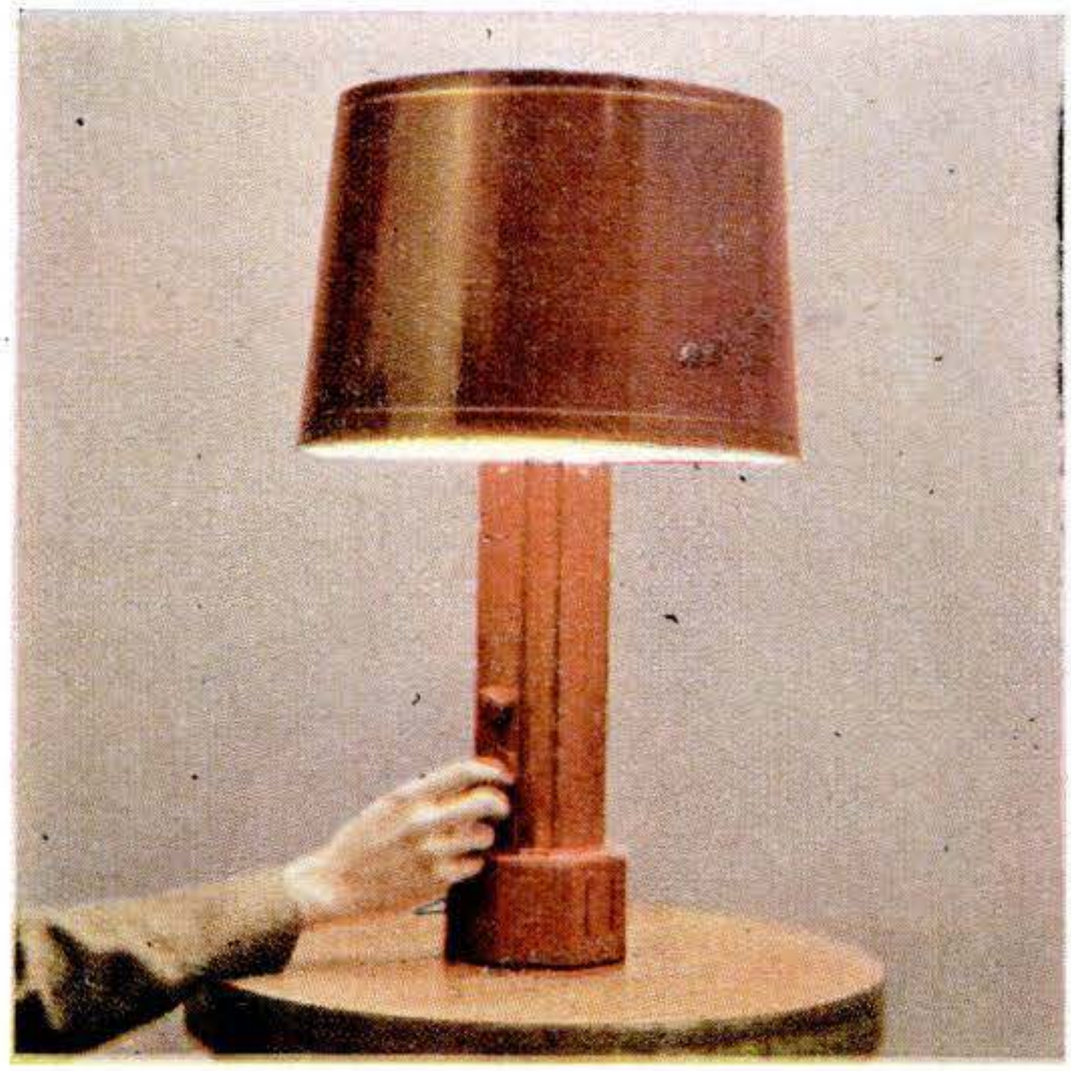


Photo by Western Ways

Navajo Makes Jewelry

His ancient skill aided by simple shop tools, a Navajo Indian craftsman fashions silver mountings for a turquoise bracelet. He buys the metal in sheets or as Mexican coins. Enough for each setting, weighed in a homemade balance scale, is melted over a gas burner and cast in a mold of wet sand.



Lamp Houses Radio

To save space on a desk, this lamp has a radio built into its base. An RCA-licensed, four-tube superheterodyne, the radio has a selenium rectifier to take the place of a fifth tube. It operates on AC or DC. The lamp is 26 inches tall and made largely of brass. A matching lamp comes without the radio. The manufacturer is Lombardy Lamps, Ltd., Long Island City, N. Y.

Colors Identify Troops

Now you can tell by the colors on his sleeve whether a soldier is a combat man or a technician. The photographs above show the Army's new color scheme for noncommissioned officers: gold stripes on a blue background for non-combat personnel, blue on gold for combat troops. The new emblems, only 2 inches wide, are about two-thirds the size of the old insignia.

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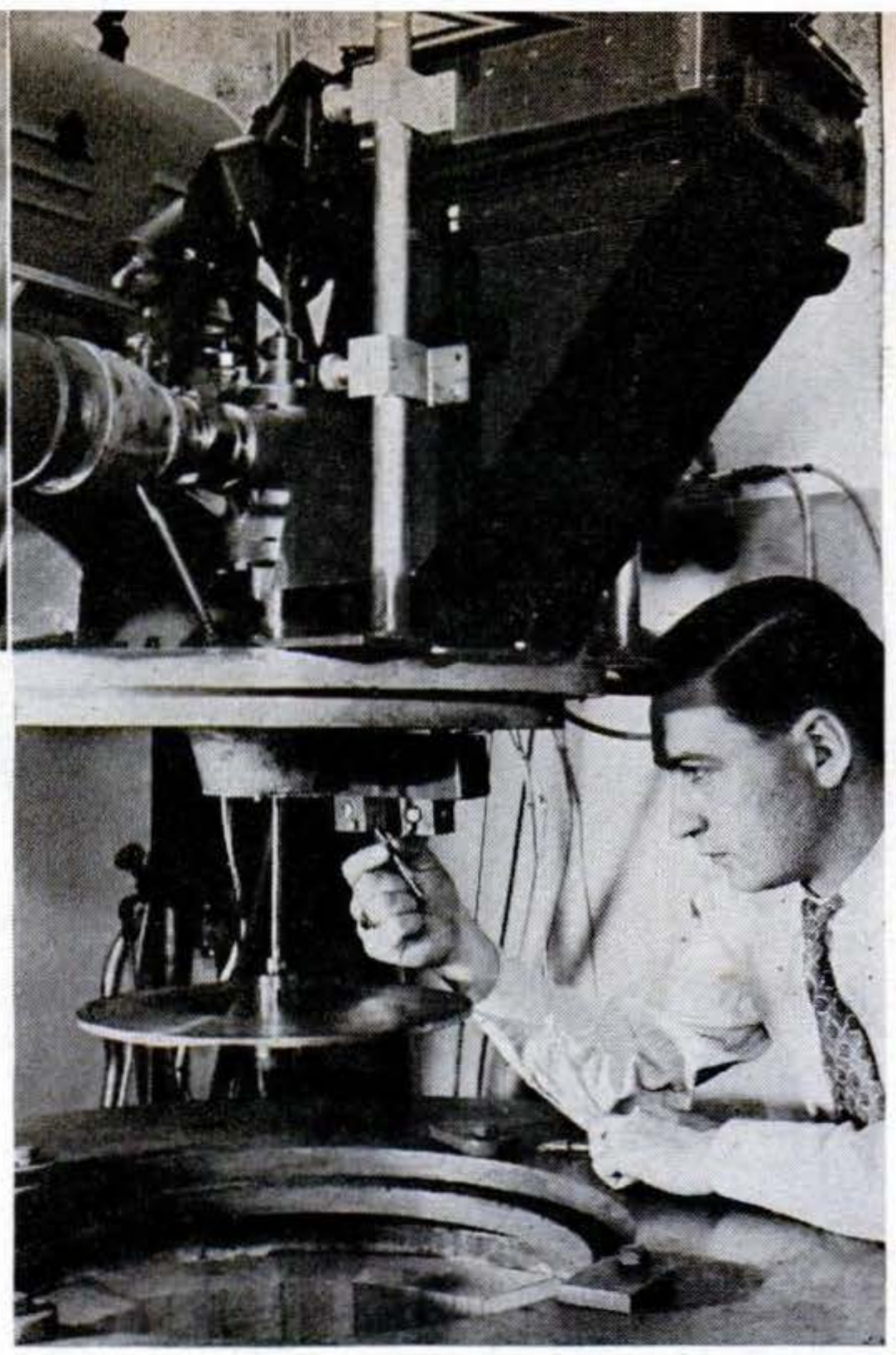
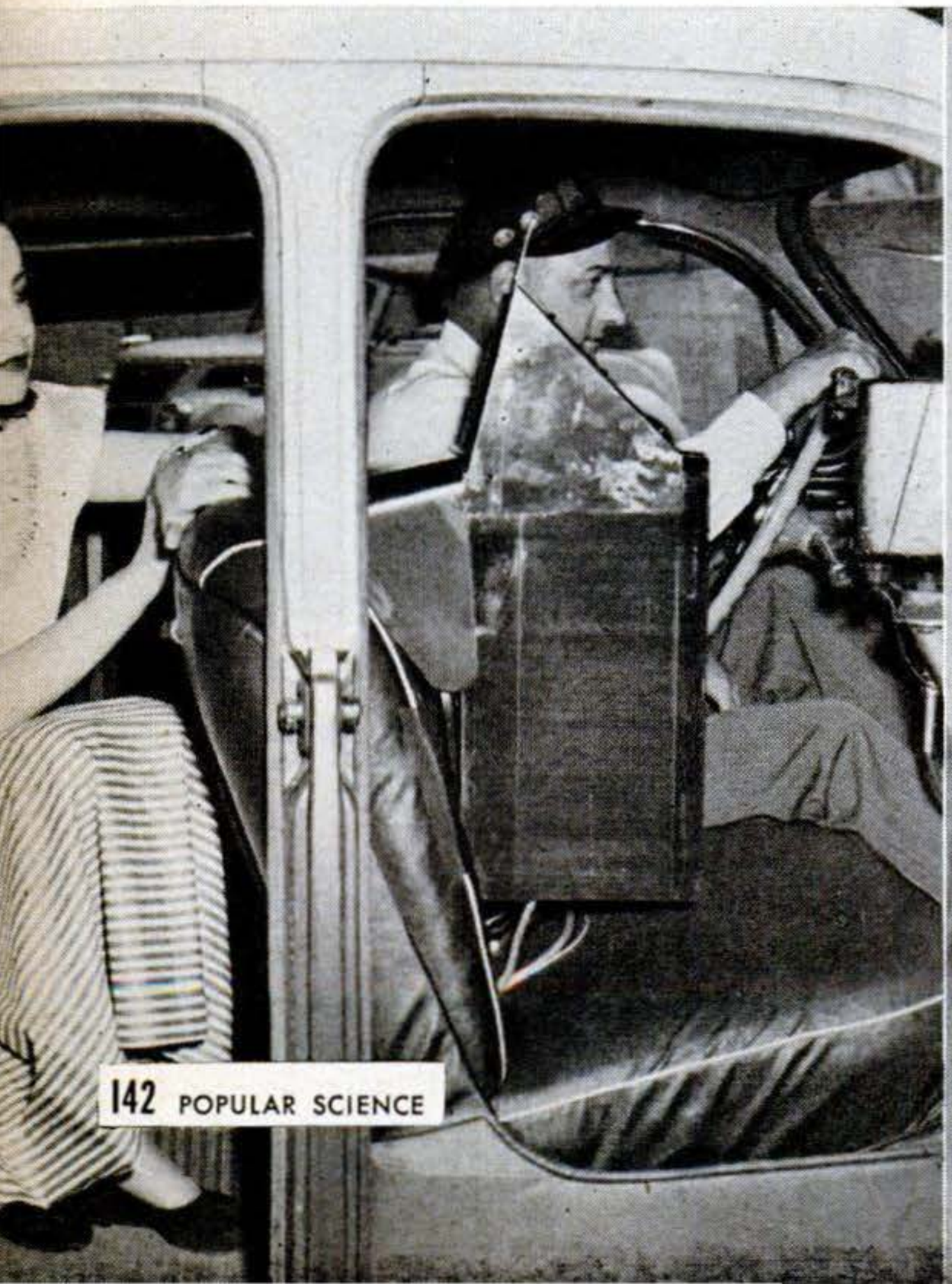


Camera Snaps Jet Flaws

How much punishment can the blades of a jet engine take? To find out, Boeing engineers place test wheels in the spin pit at the bottom of the picture at right and whirl them at speeds up to 100,000 r.p.m. under temperatures as high as 1,750° F. When a wheel breaks, a tiny mercury flash lamp, shown being installed at right, is set off, making a 1/5,000,000-second photograph on film in an 8-by-10 camera mounted above the pit. The photo above was snapped as a wheel burst at 52,000 r.p.m.

Taxi Gives Tele Shows

You can see the fight, even though you are stalled in a traffic jam outside the gate, if you're lucky enough to hop into this Chicago cab. The set is a Motorola table model, modified by a television engineer, and set beside the driver so that the 4½-by-6-inch screen is visible from the rear seat. Requiring only 70 watts of power, the set has a special vibrator that permits its operation without added battery power. The antenna designed for the job is shown at the right. The whole thing cost only $200.



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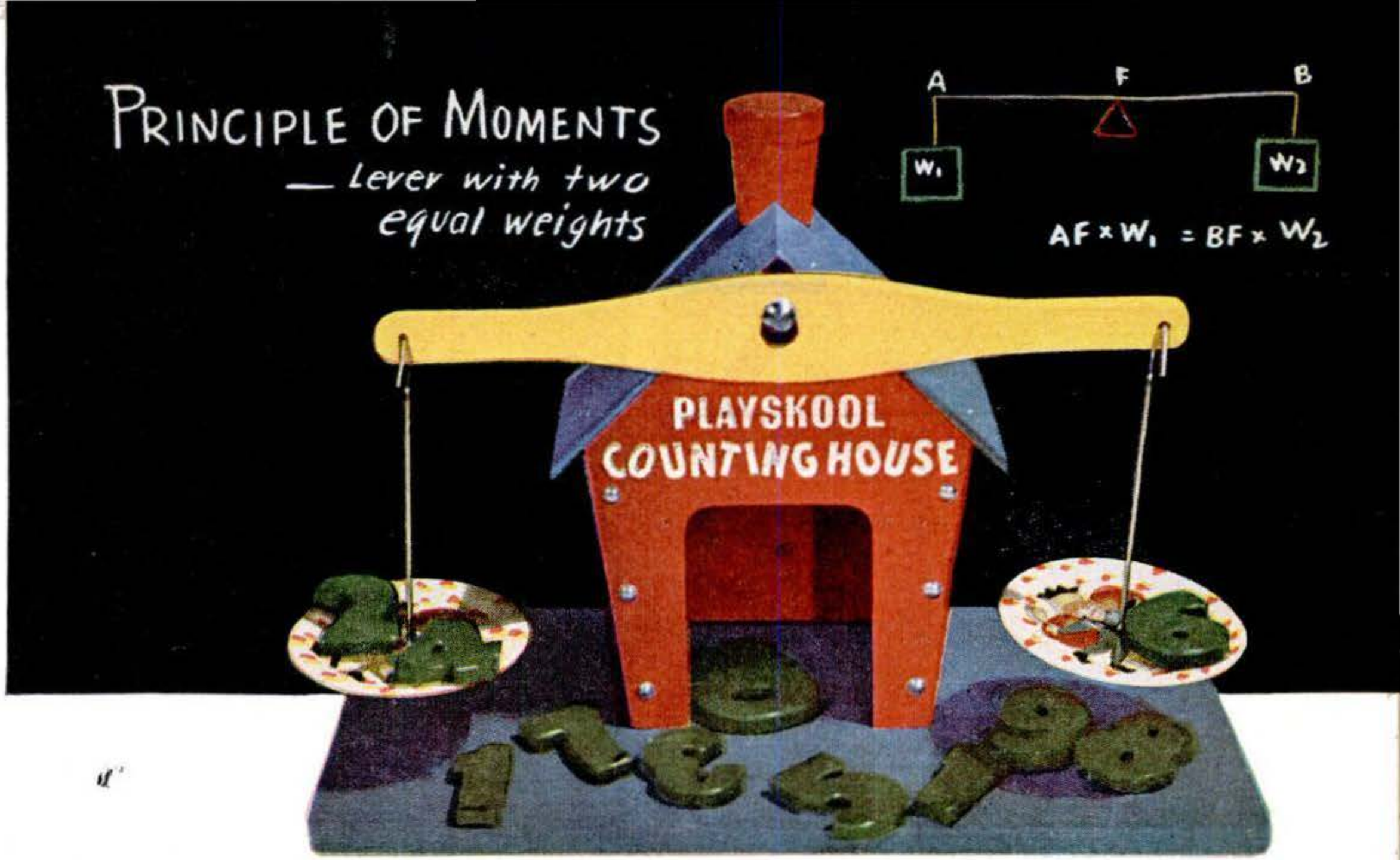
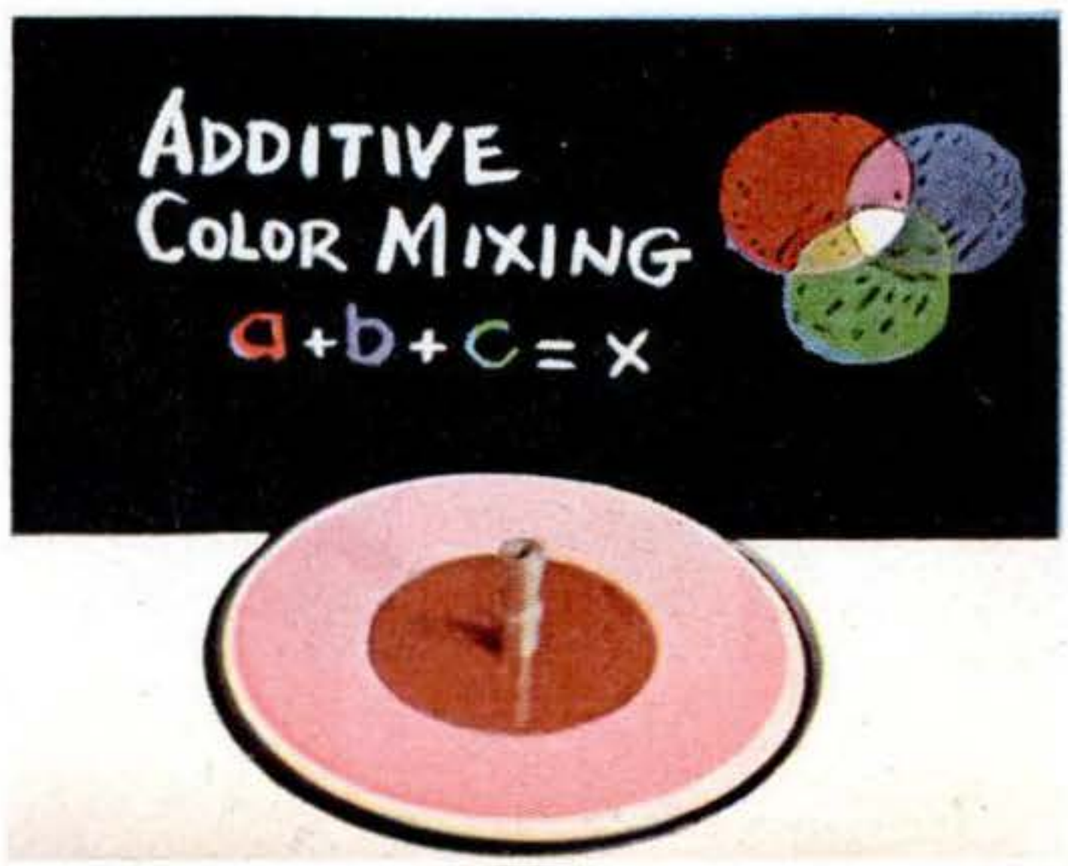


Simple scale shows that only equal weights balance at equal distances from the point of support, or fulcrum. This is based on law of moments: ability to make a body rotate about an axis is measured by multiplying the force used by its distance from the axis. The Counting House Ⓣ, made by Playskool Mfg. Co., also teaches addition: the counters are shaped like numbers proportionate to their weight, so that the 2 and the 4 are exactly balanced by the 6.

Toys Dramatize Science

THE laws of science rule the nursery as well as the laboratory, and many a profound physical principle is dramatically demonstrated by a toy. Here are half a dozen in which Junior has gotten an assist from heavyweight thinkers like Archimedes and Sir Isaac Newton. They were selected at the Toy Guidance Exhibit, Inc., of New York City, an information and display center for the toy industries and educators.

Color top employs additive mixing of hues. Red and blue sections of the top blend to appear pink when the top is spun. The eye sees a fraction of the light from each color as it whirls and adds up the wave lengths in the brain. Blackboard formula shows that if green were added, top, made by Falge Engineering Service, of Bethesda, Md., would spin white.



"A simple train of gears is one in which each gear meshes with the next one; each gear being a follower of the one preceding and a driver of the one following"—as this simple toy demonstrates. Gears and pegs are removable and can be given different positions by shifting to extra holes in the board. Paul Bonhop, Inc., of New York City, makes the gear-train set.

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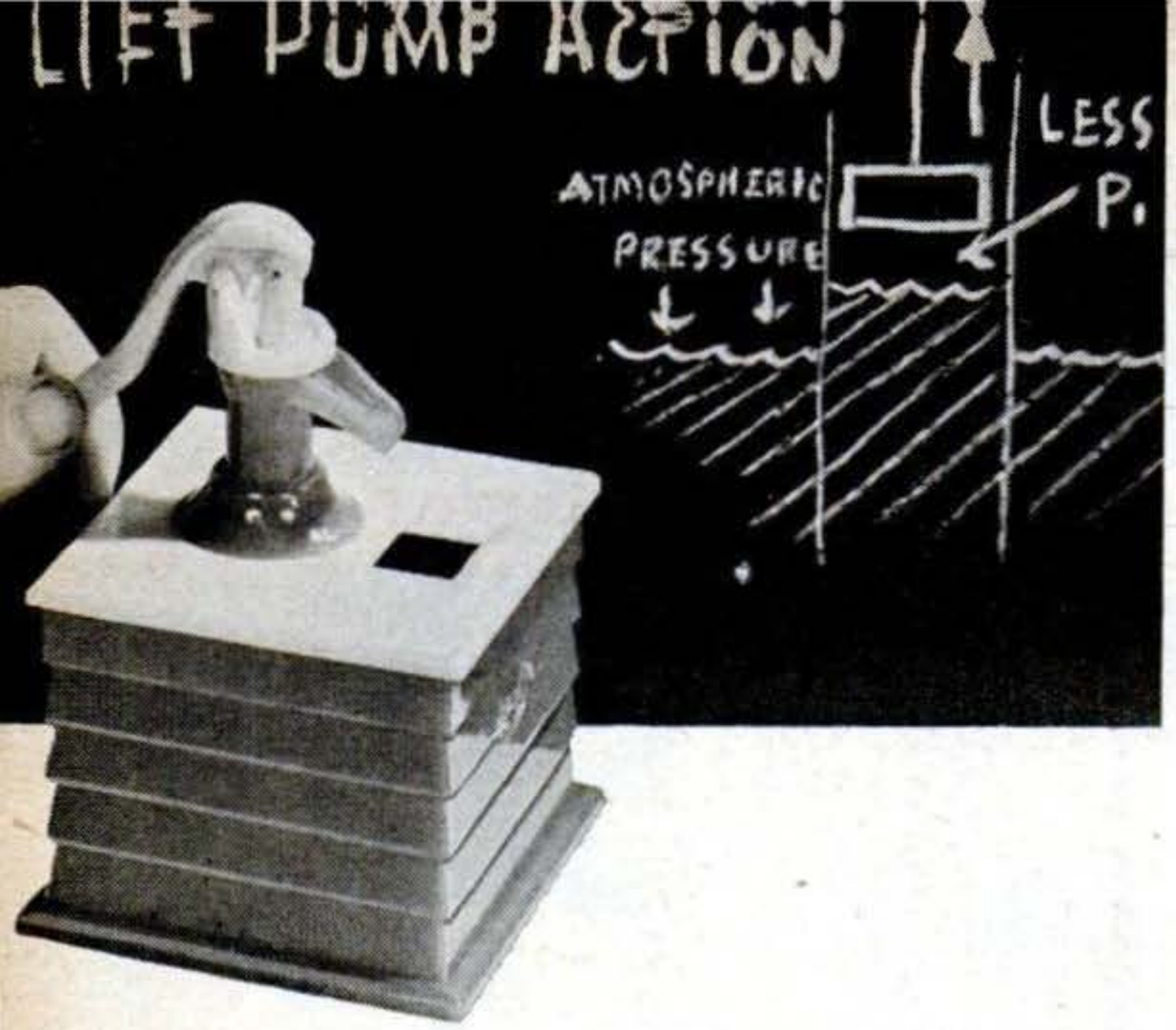
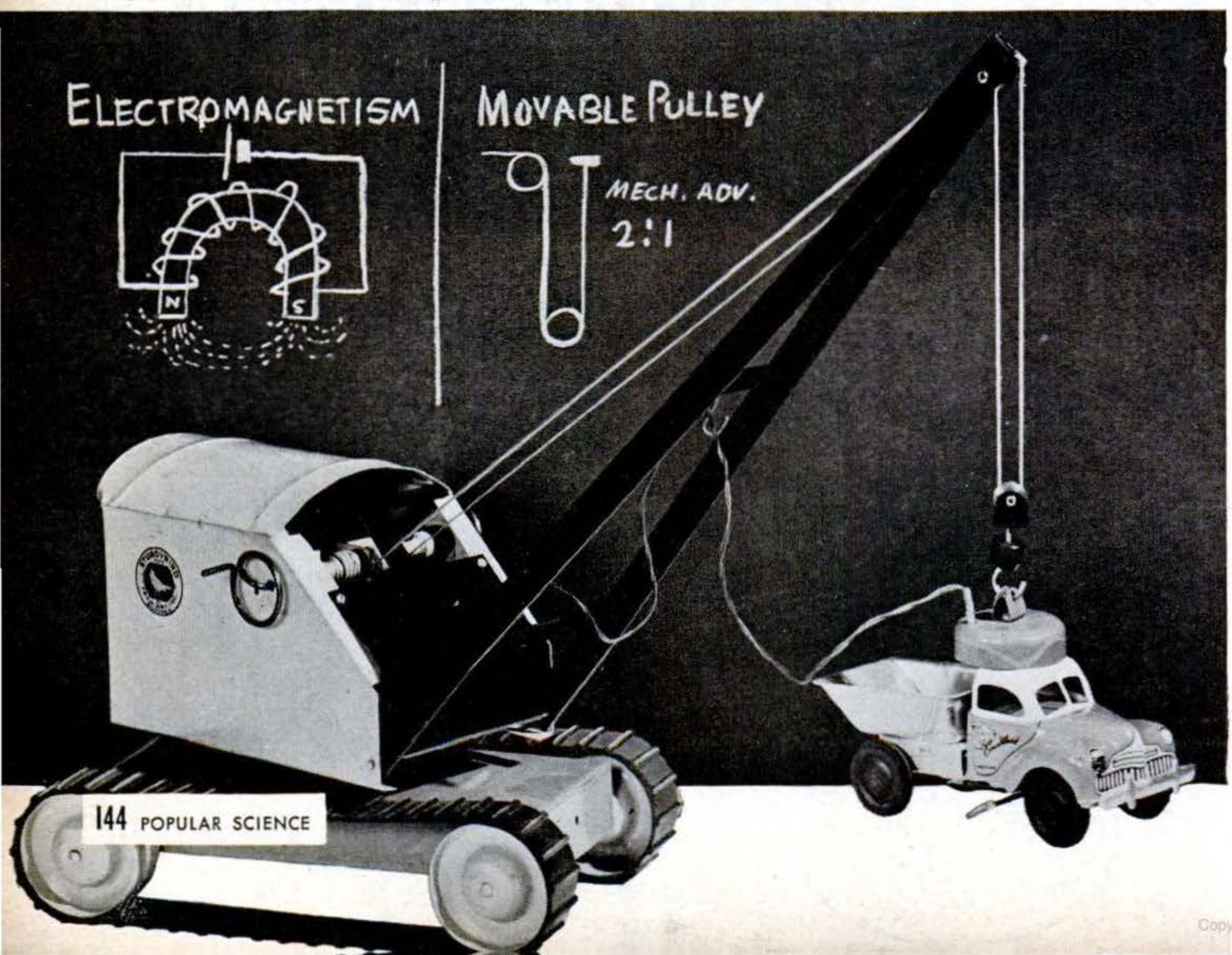


In this toy pump, just as in a full-sized one, **the pressure of the atmosphere on the surface of the well water forces the fluid up into the** pump. This happens when pushing down the pump handle raises the piston, lowering the air pressure in the pump cylinder. The up stroke on the handle then pushes the piston down and the water passes through a valve in the piston. The next stroke then lifts it to the spout. In the toy, made by Ideal Novelty and Toy Co., a little water poured through hole in pump top gives an endless supply for pumping.

Perfectly balanced on its stand, the spinning **gyroscopic top above demonstrates that a rotating body persists in the plane of its rotation,** unless affected by an outside force. This law of motion was first explained by Sir Isaac Newton. Formula on blackboard is for gyro's precessional velocity. Weight of top and push of pivot are equal; the two forces thus form a couple, and top does not fall. The toy, made of plastic, is spun by pulling a string, which is first wound around the axis. Toy Founders, Inc., of Detroit, Mich., manufactures it.

This crane uses one of the most valuable tools with which science has equipped industry—the electromagnet. The French physicist Arago first showed in 1820 that winding a soft iron core with wire carrying a current makes a powerful magnet. This one, battery-operated from the cab, will lift 10 lb. of iron. The toy also demonstrates the mechanical advantage of the pulley. Since each rope hitched to the pulley on the crane exerts a pull equal to half the weight of the load, it has an advantage of 2 to 1. Tech-Art, Inc., of Milford, O. makes the toy.



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Bouncer Tests Springs

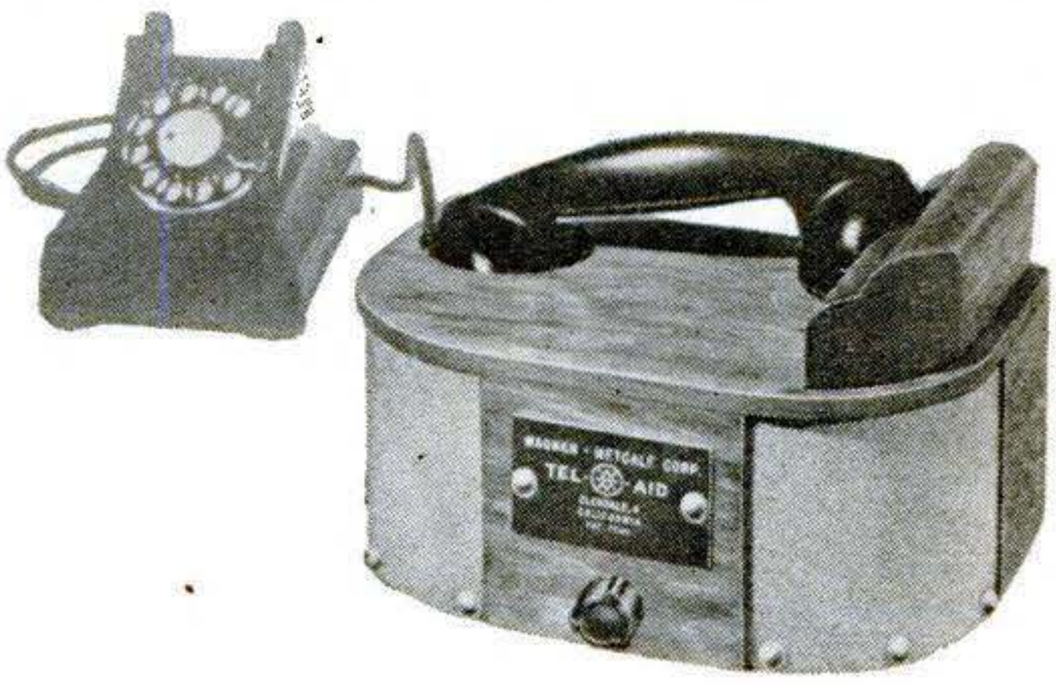
THE motorized bump shown above is part of Kaiser-Frazer's indoor proving ground for proposed changes in automobile design. Its whirling drums, set off center, spin the car wheels mounted above them and, at the same time, alternately shove one wheel up while letting the other drop. This tests springs and shock absorbers by putting them through more punishment than they're ever likely to encounter on the road.

Glass Tube Samples Steel

THE picture below shows how GE's oversize "medicine dropper" samples molten steel. Squeezing a rubber bulb on its upper end sucks liquid metal from a dipper into a tube of heat-resistant glass about the diameter of a lead pencil. The steel hardens in five minutes, and the glass is cracked away—leaving a smooth rod for analysis.

Phone Aid Frees Hands

JUST flip the switch of the Tel-O-Aid ® when the phone rings—and you can talk, with both hands free and work uninterrupted. Both sides of the conversation can be heard anywhere in the room. The receiver rests on the cabinet, plugged into any outlet, but has no mechanical connection with it. Outgoing calls are dialed as usual.



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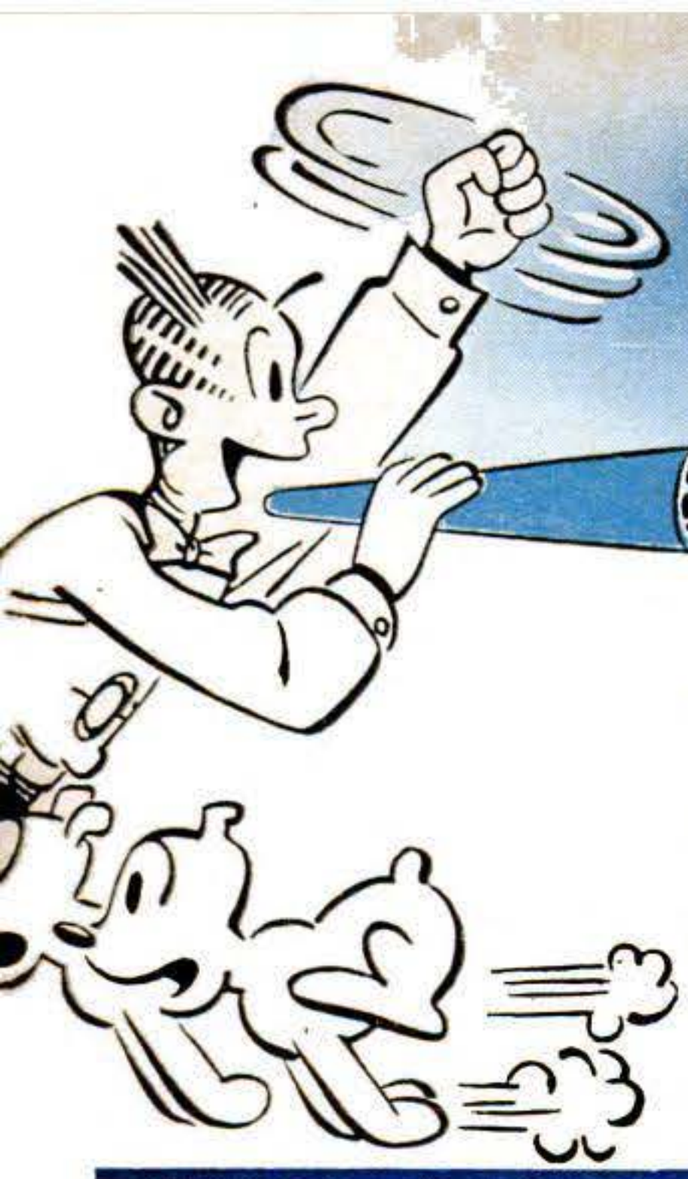

DAGWOOD Splits the Atom

TO MAKE atomic energy easier to understand, this comic strip was prepared for an exhibit celebrating New York City's Golden Anniversary. Artist Joe Musial was aided by Dr. John R. Dunning, Nobel prize winner and Columbia University science director; Dr. Louis Heil of Cooper Union; Dr. Maxwell L. Eidinoff, author of "Atomics for the Millions"; representatives of "Puck"; and a group of science journalists.

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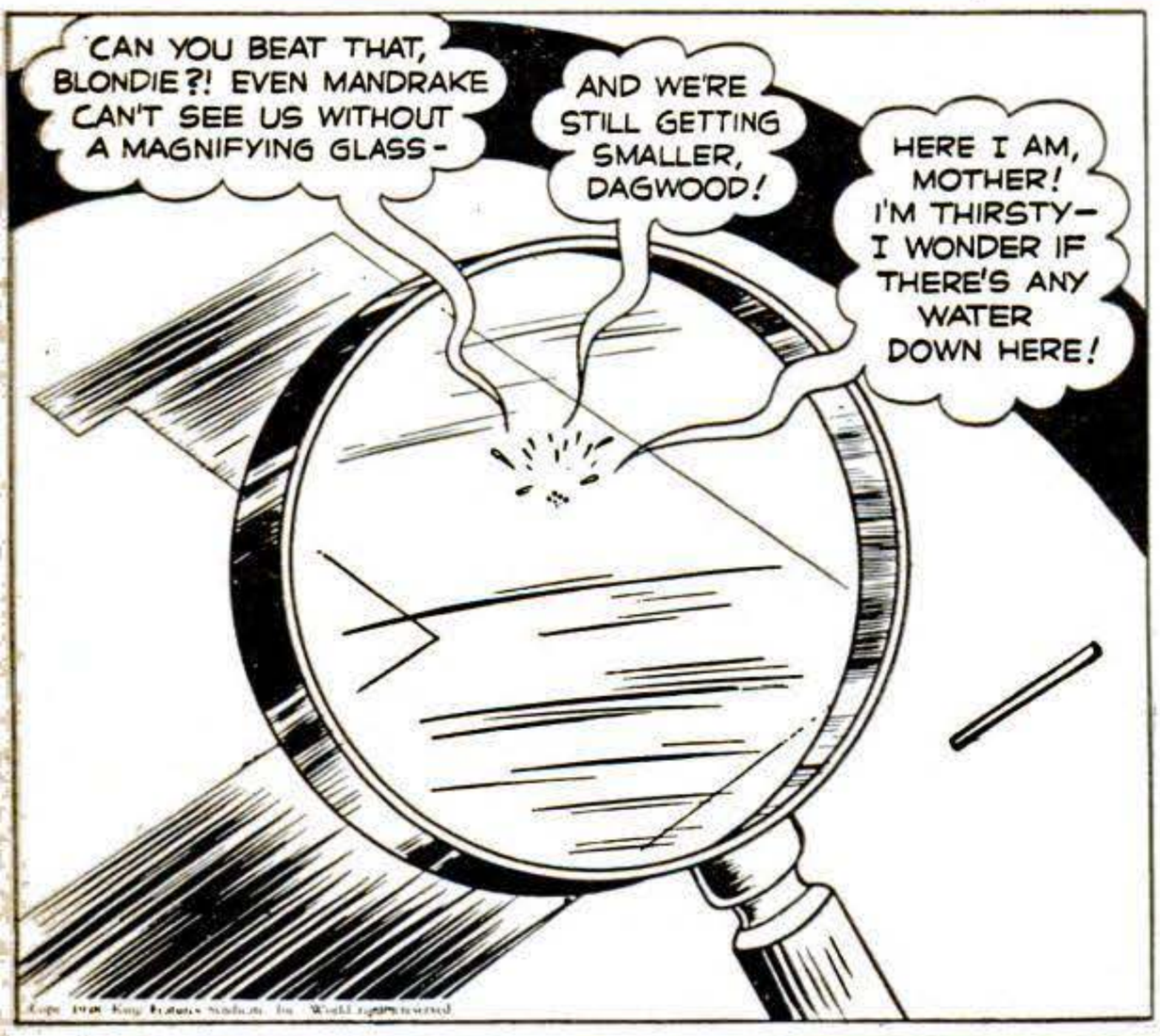

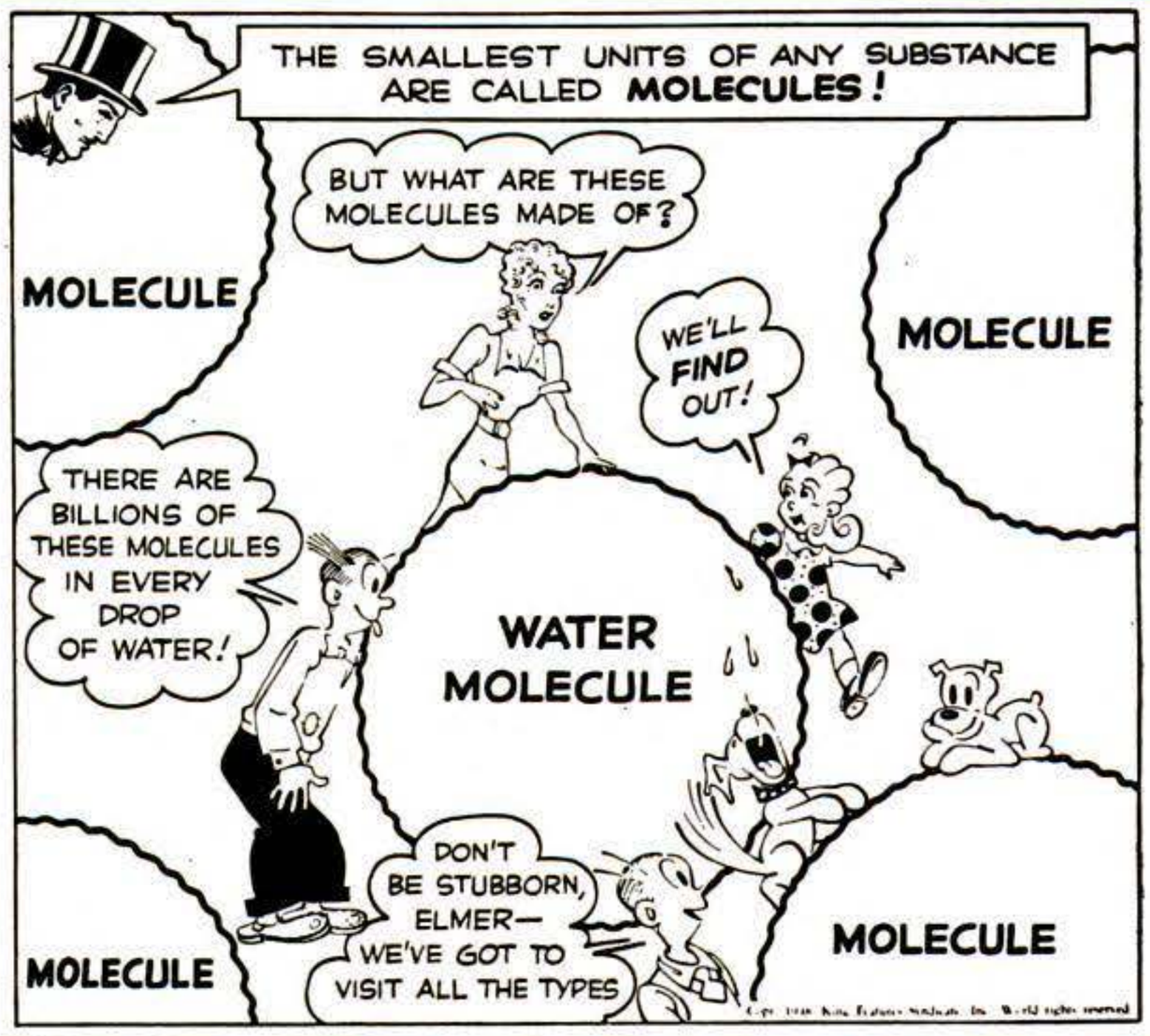

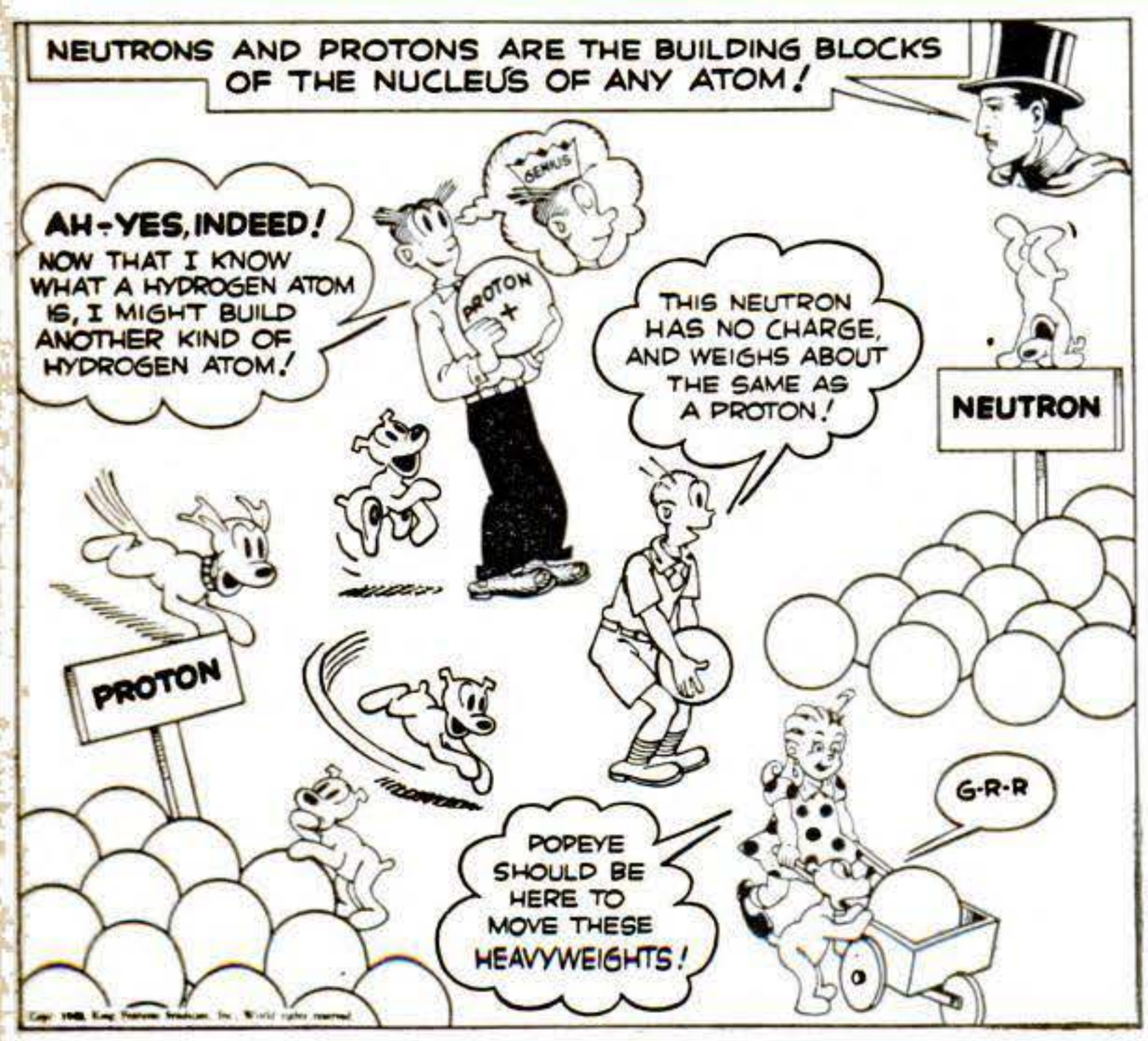

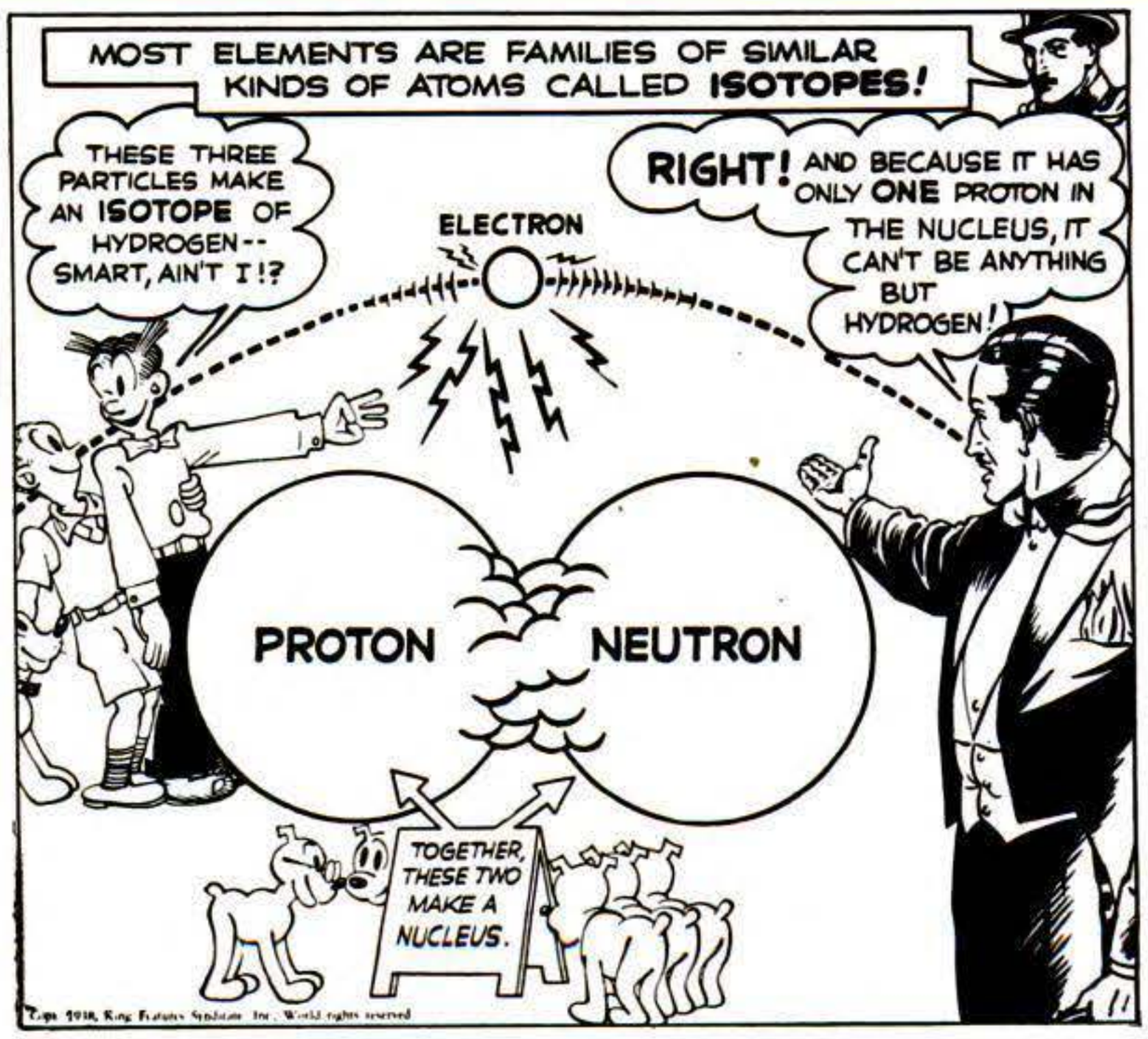

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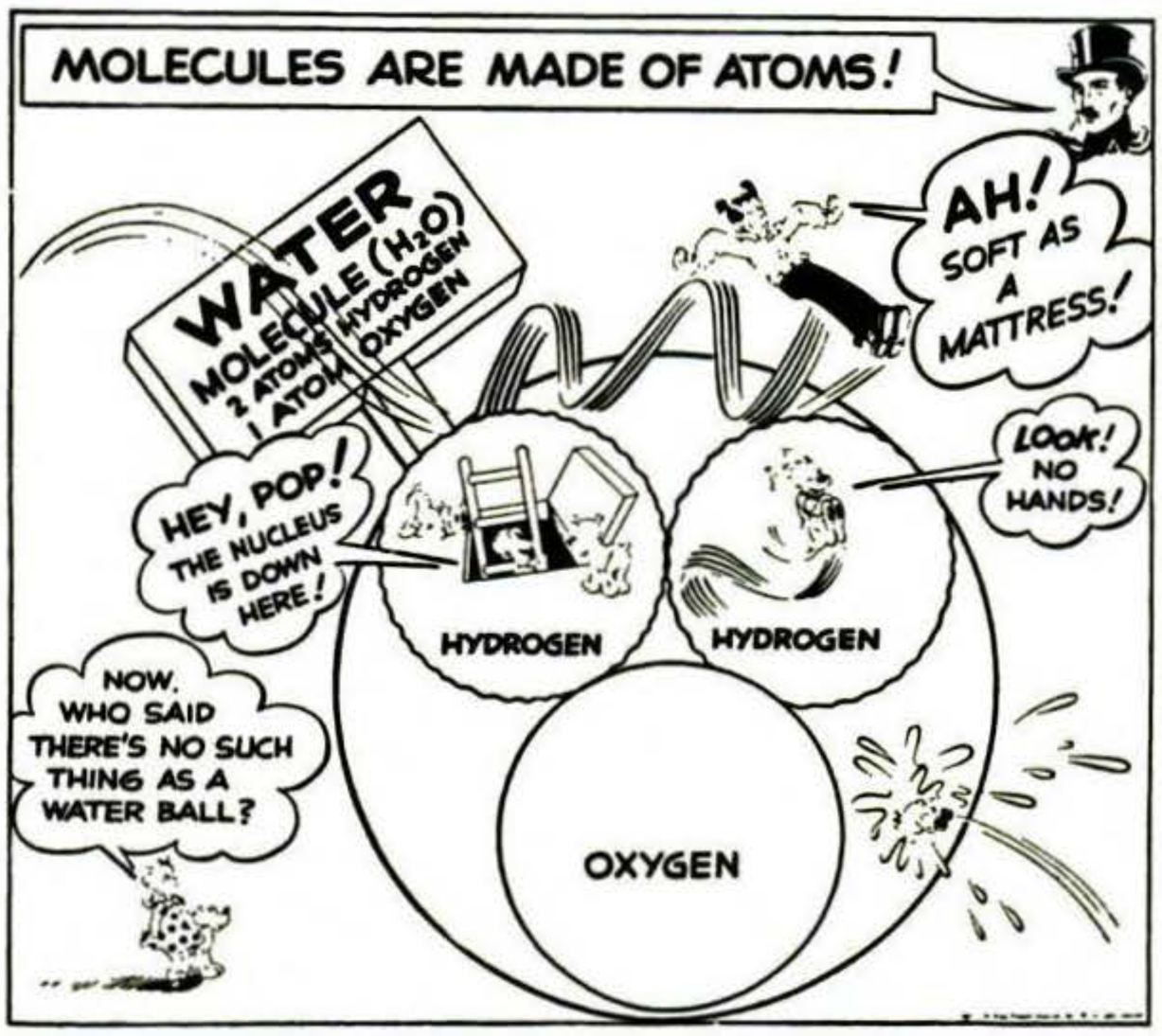

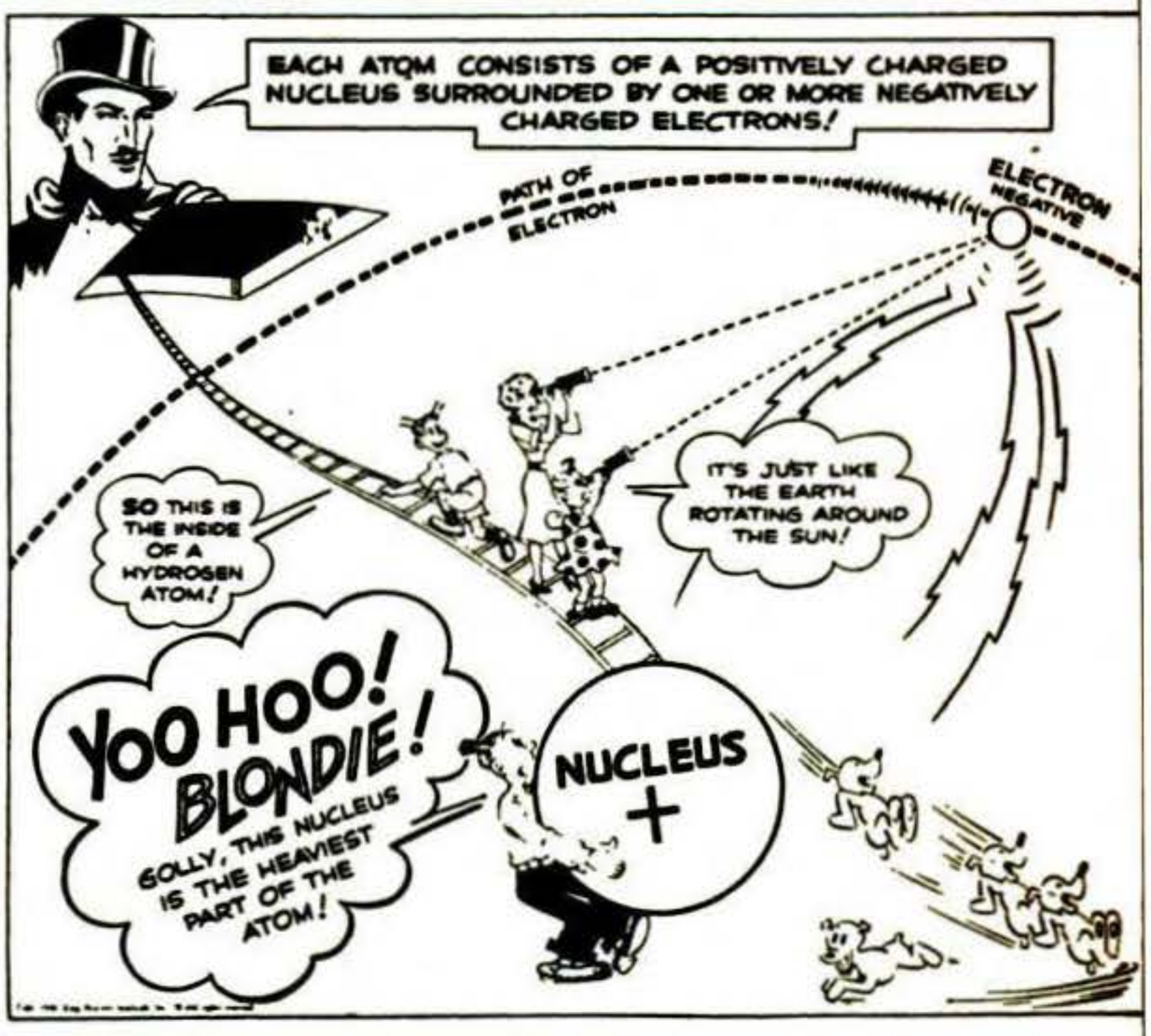

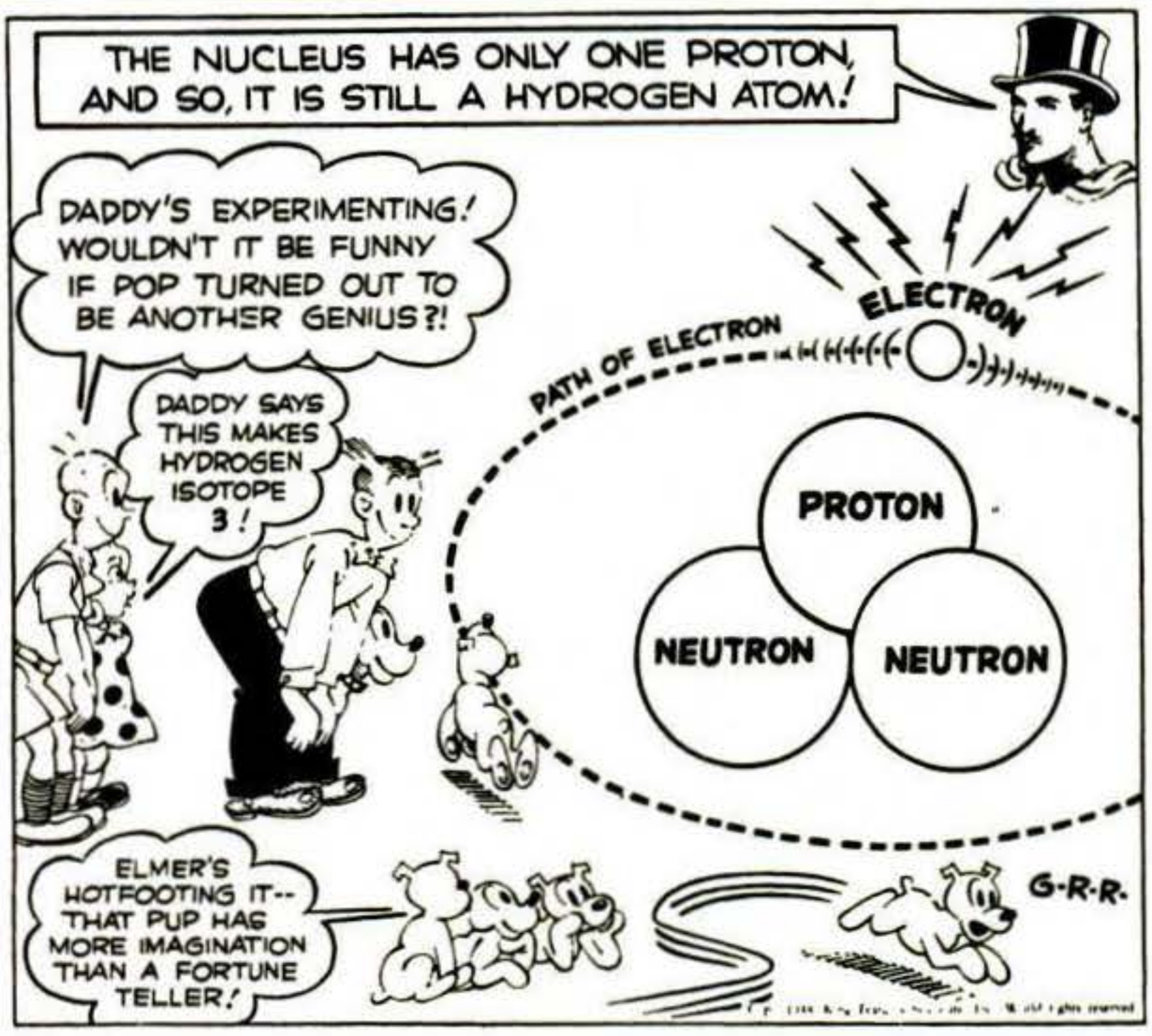

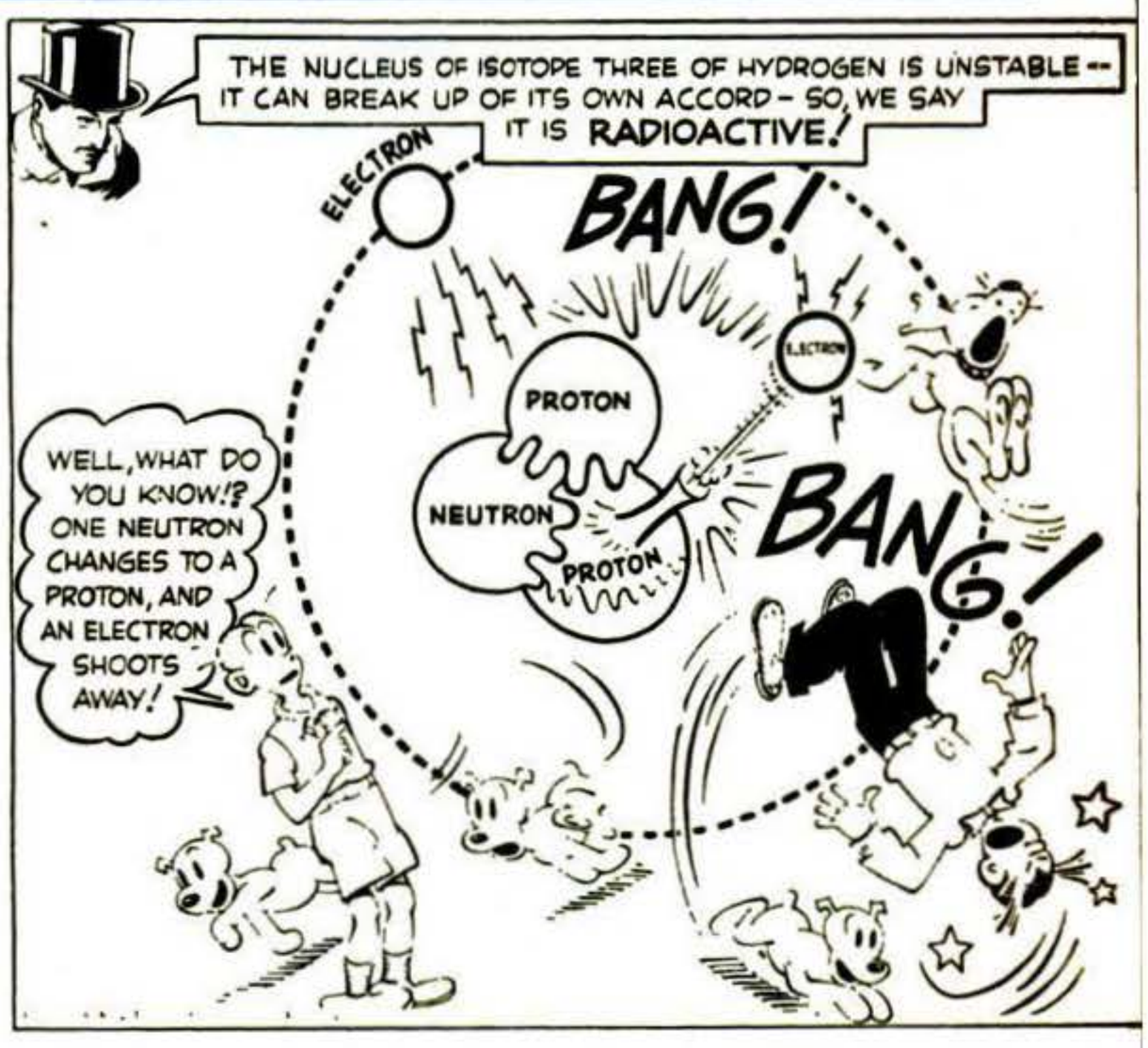

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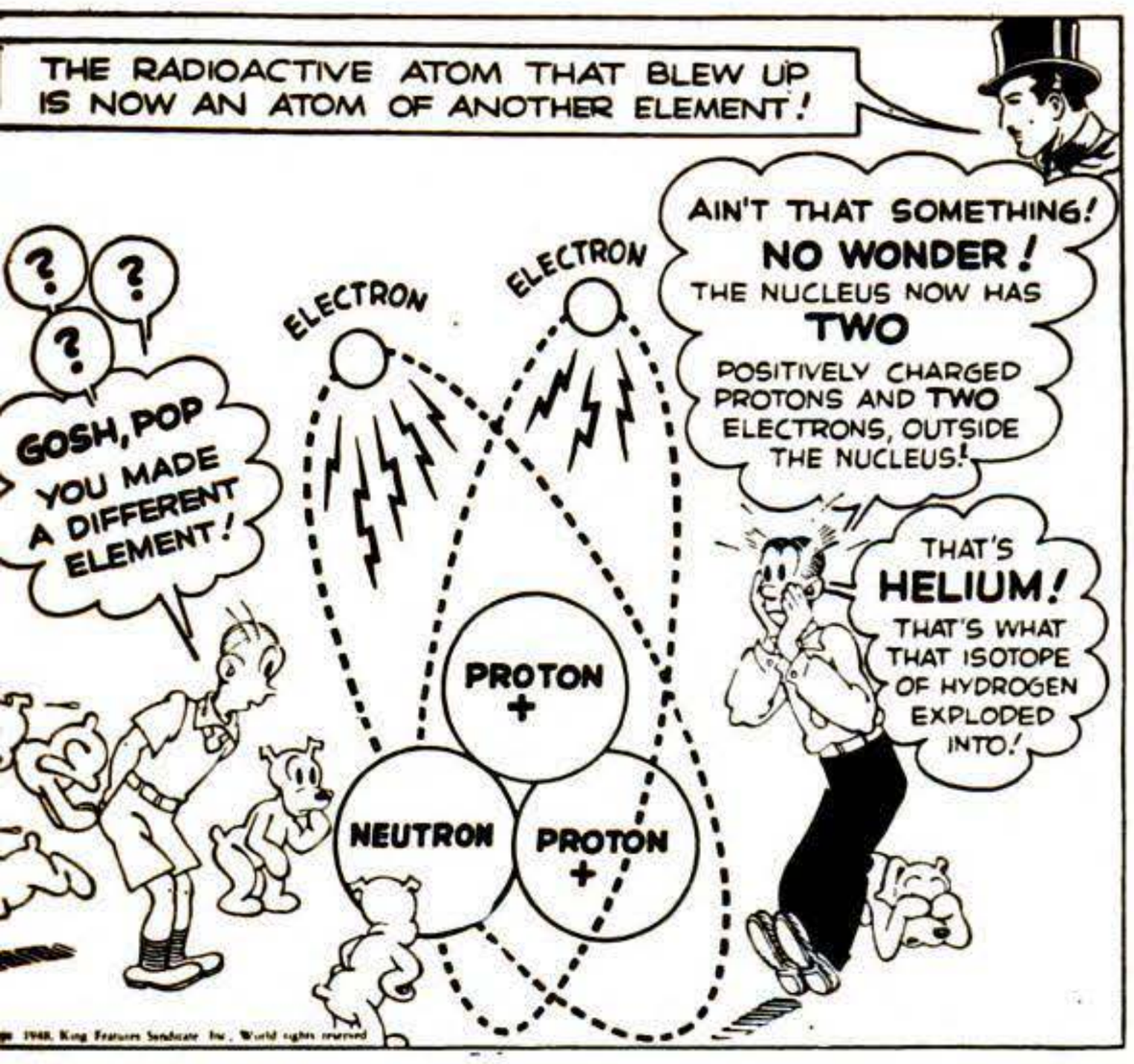

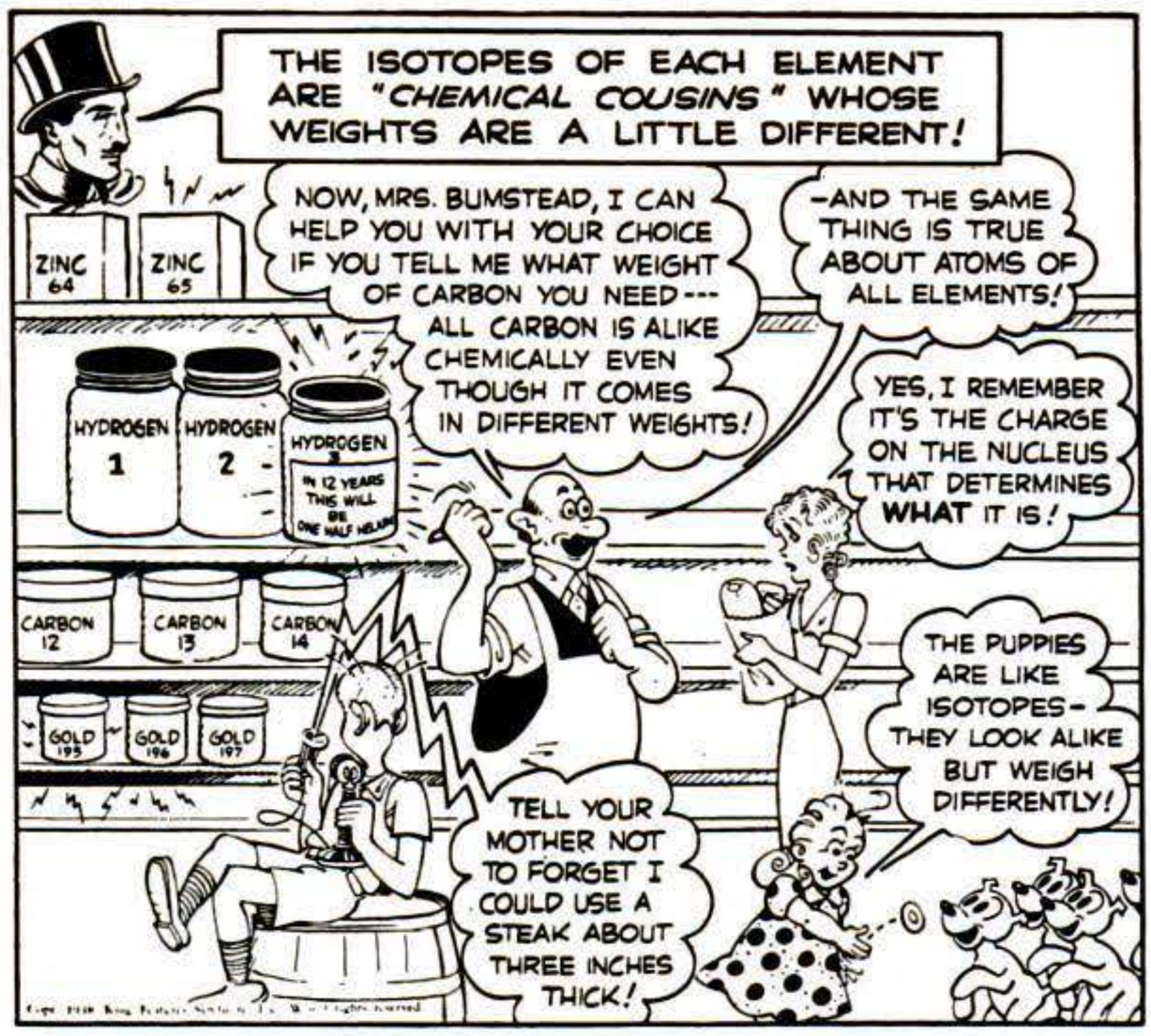

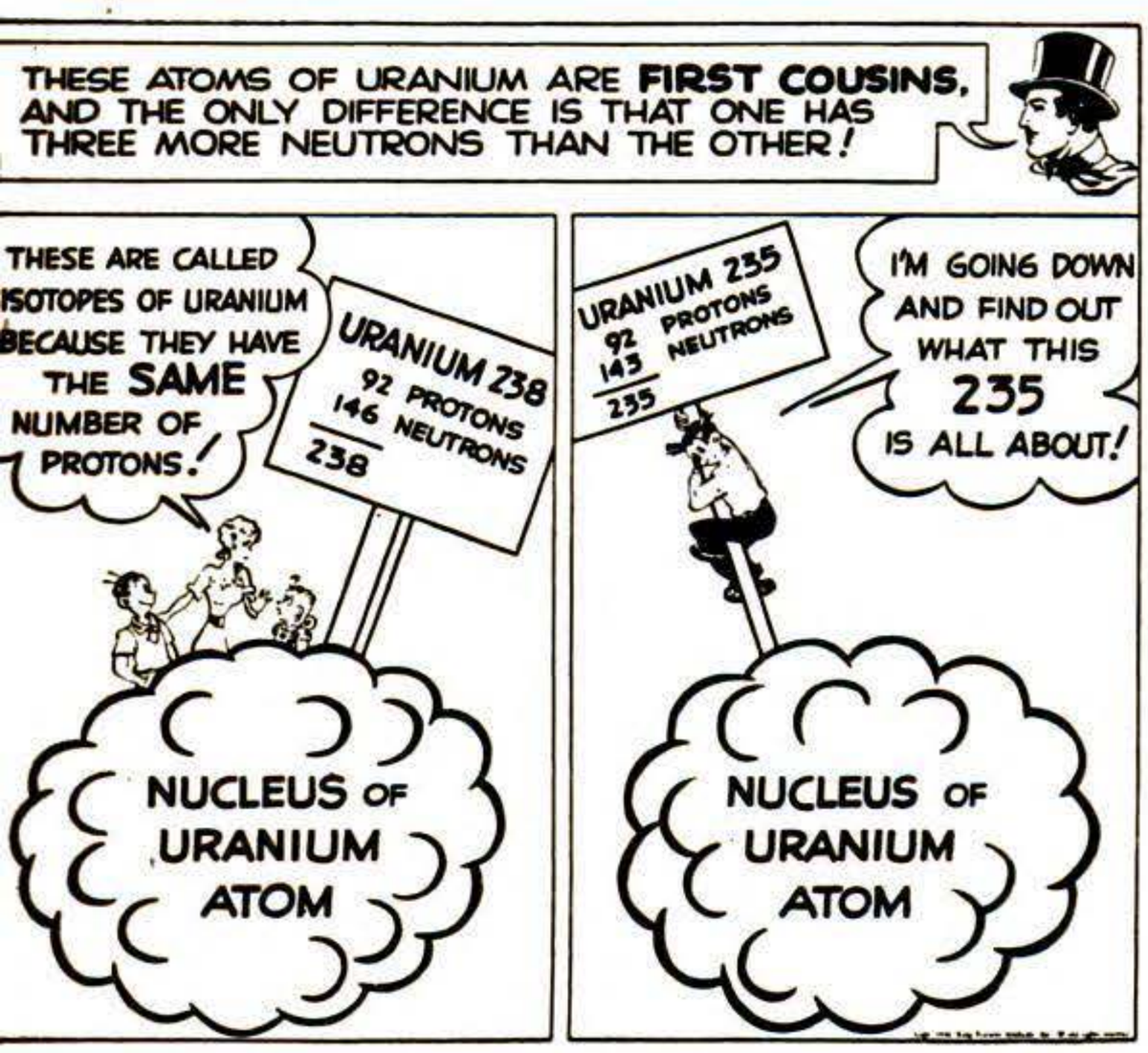

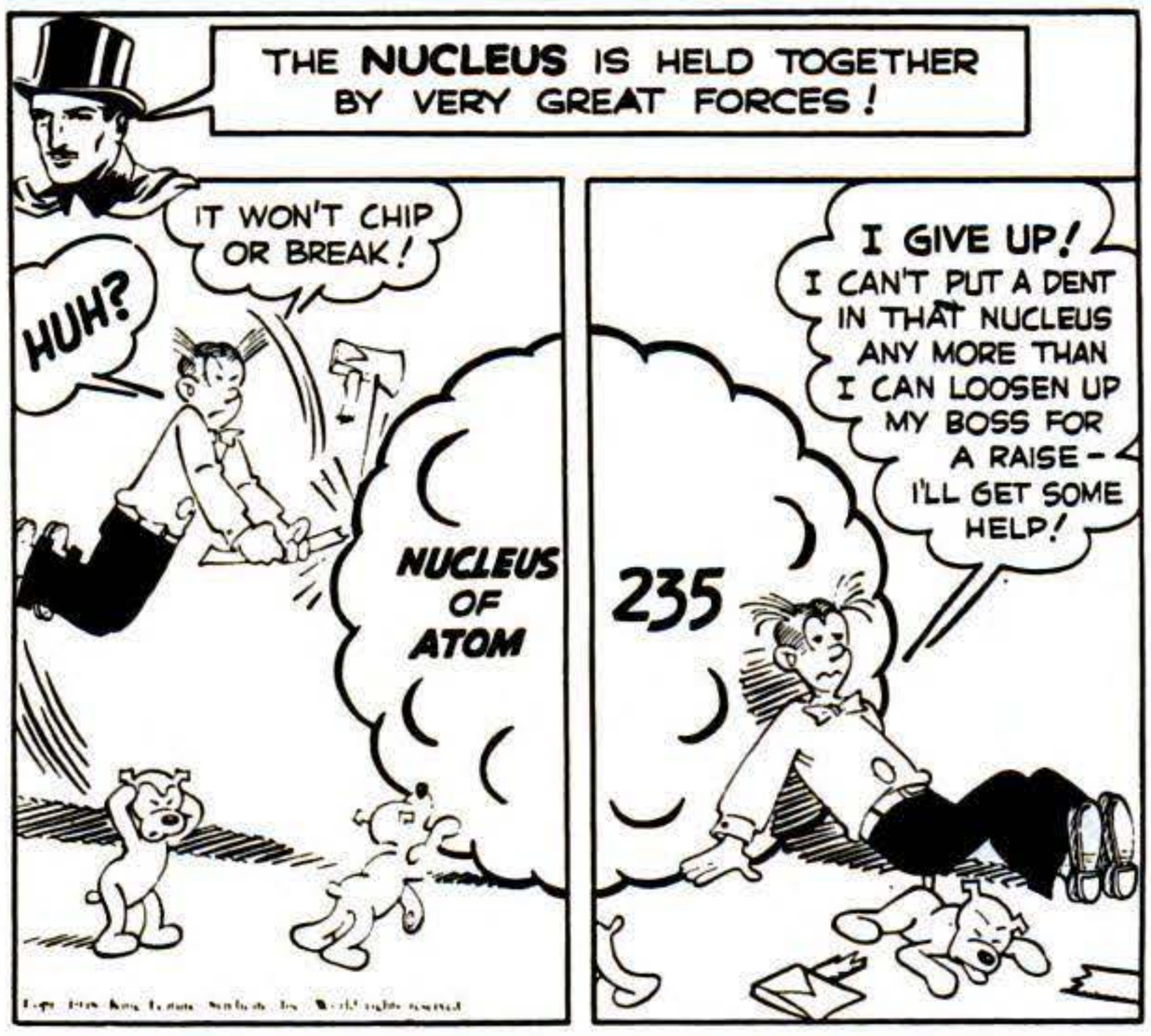

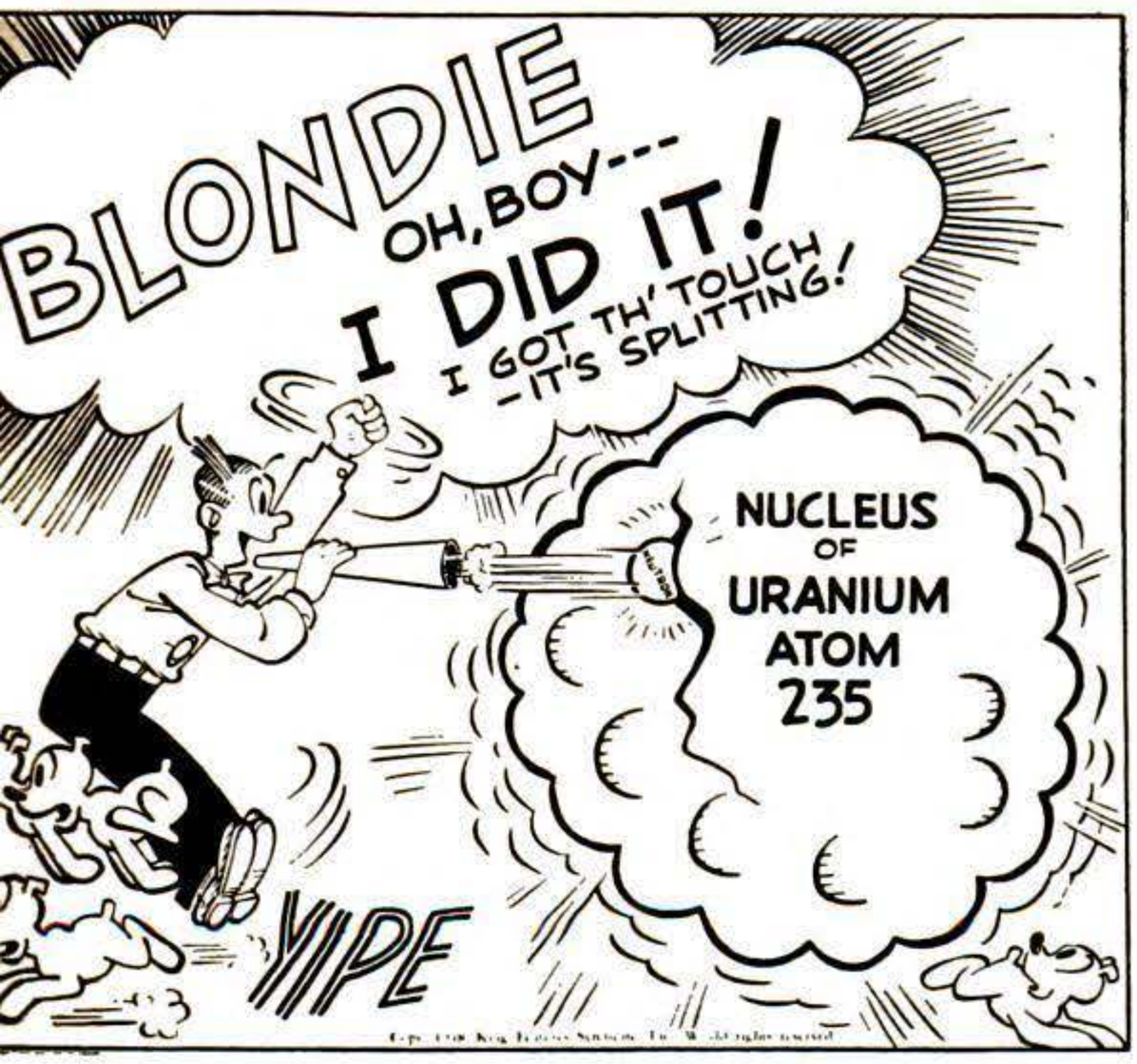

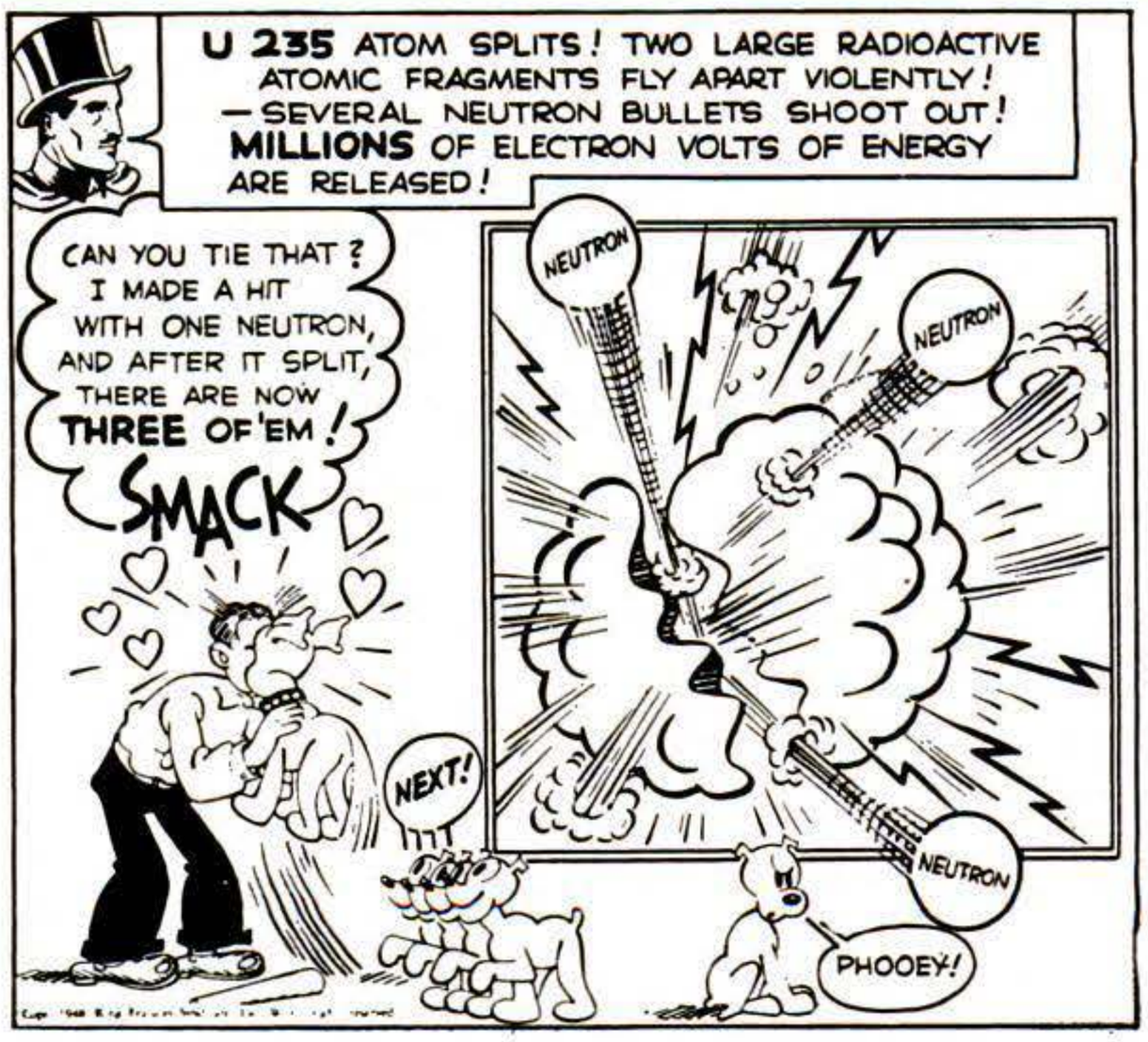

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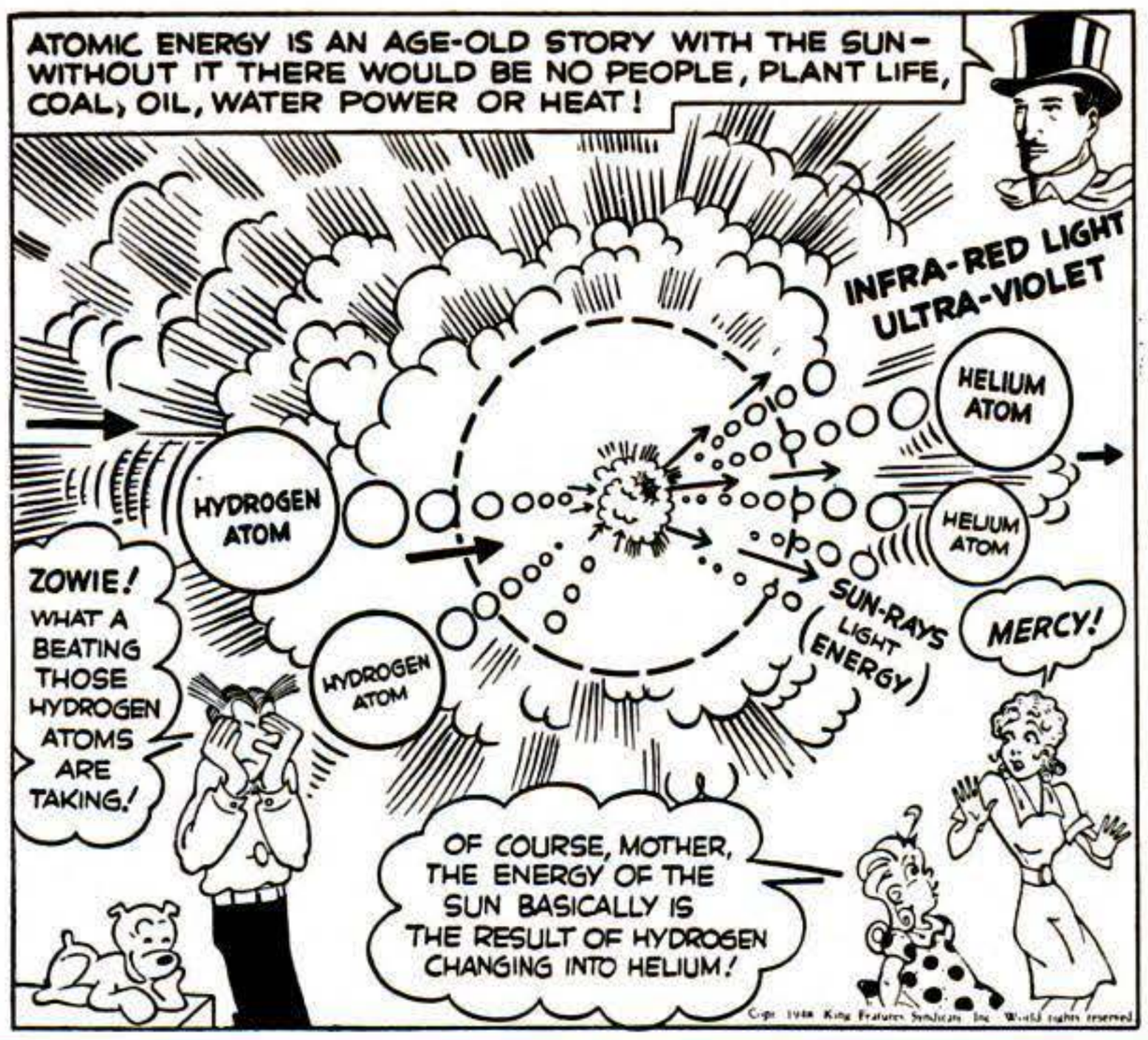

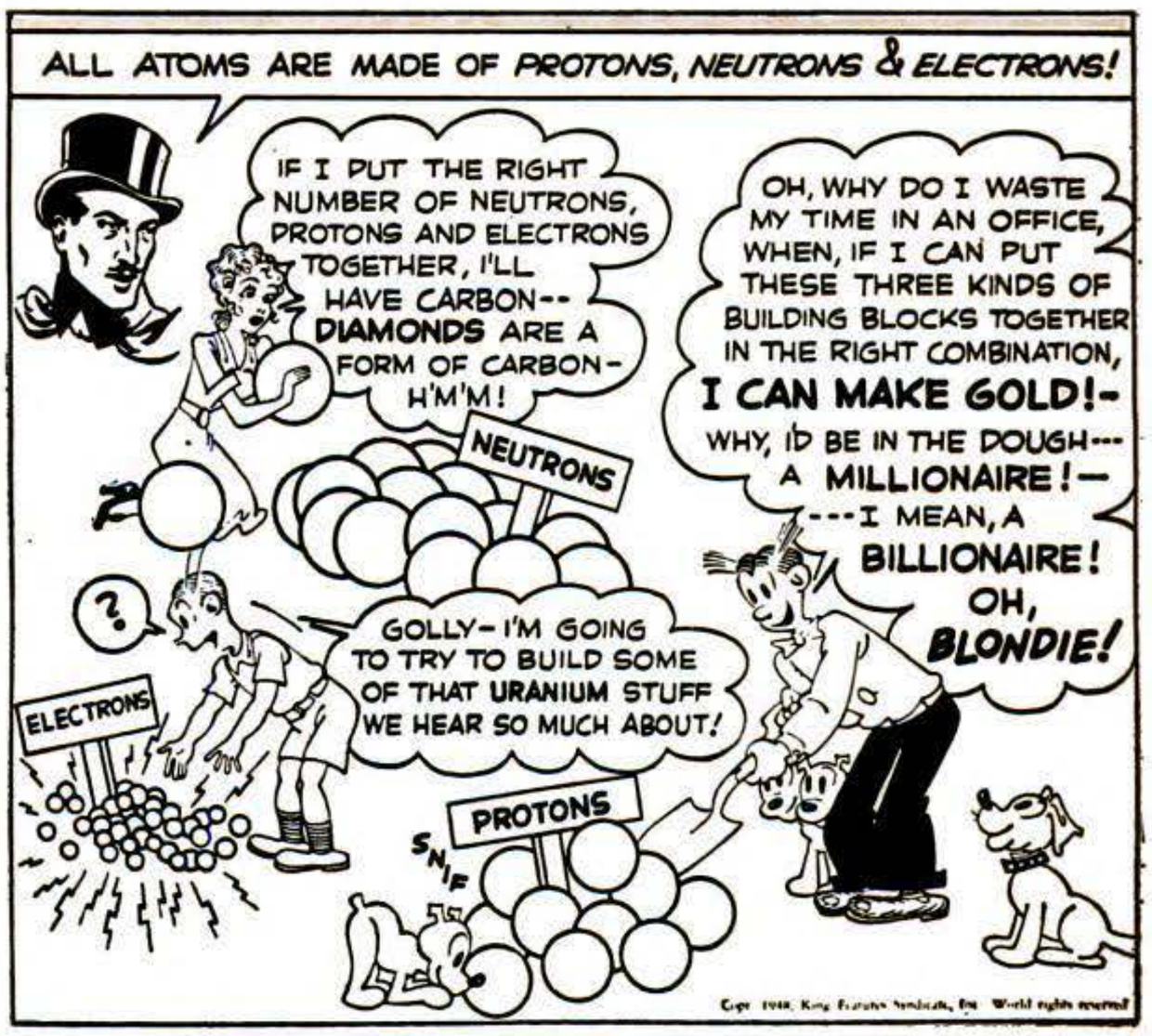

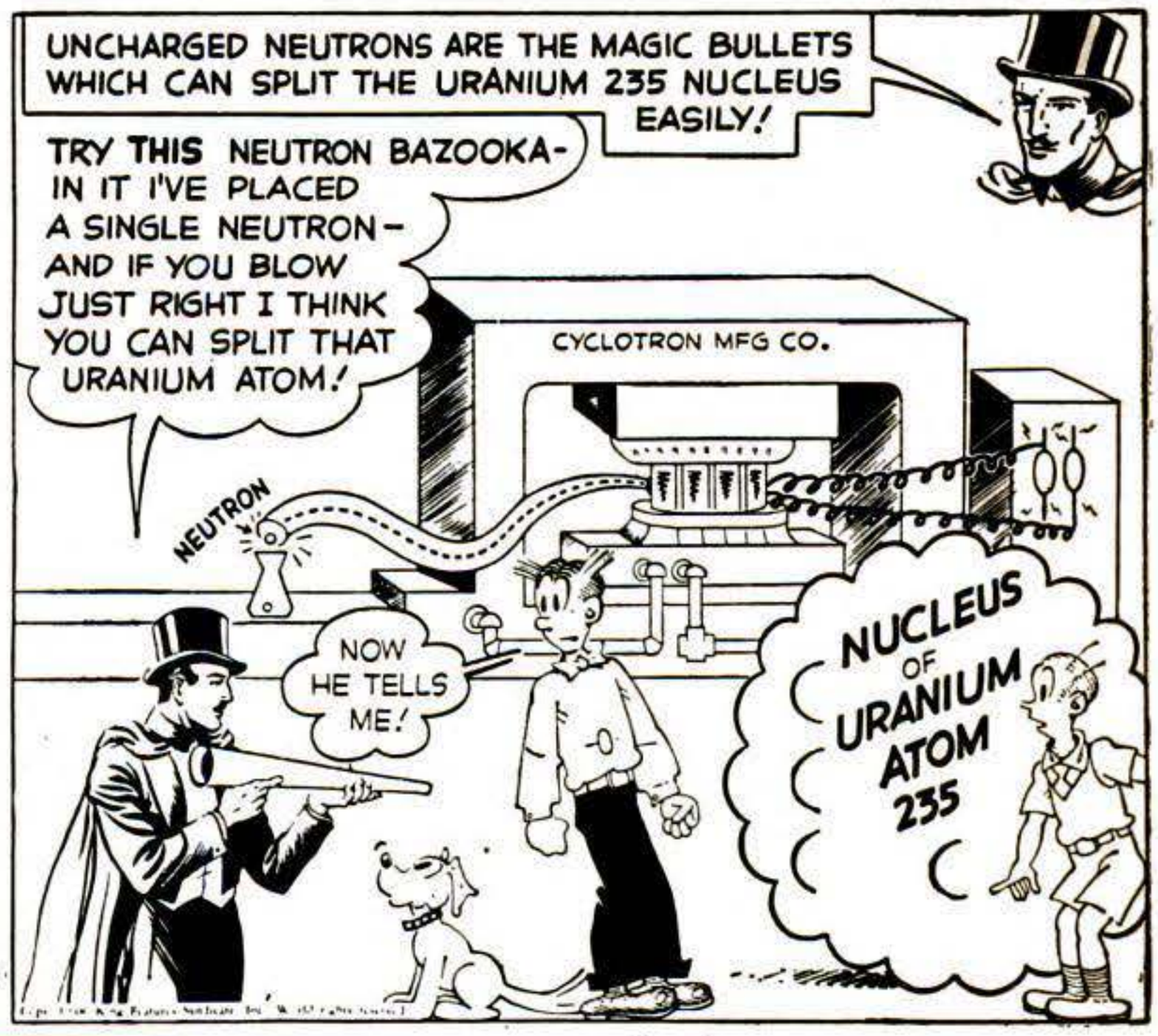

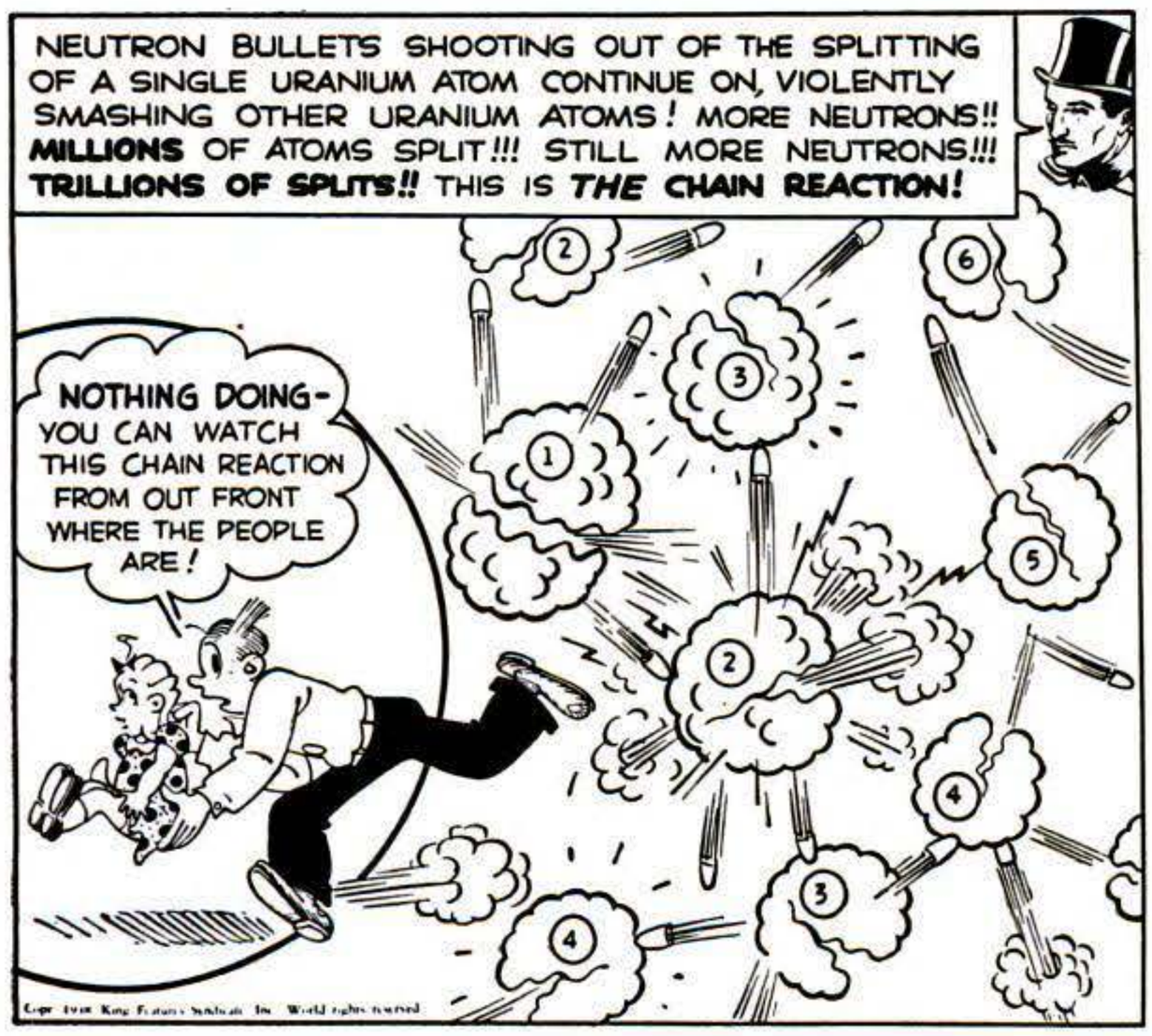

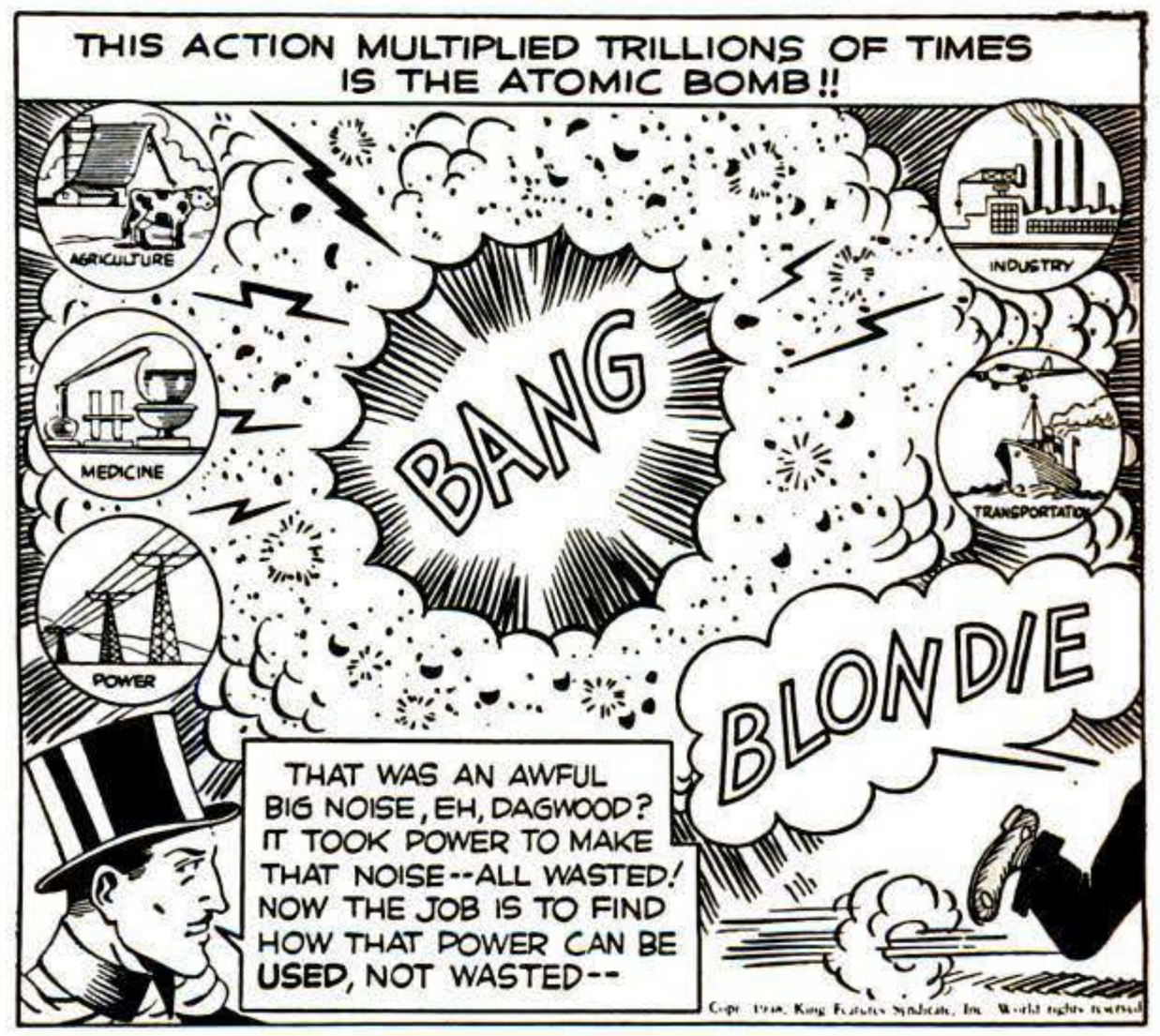

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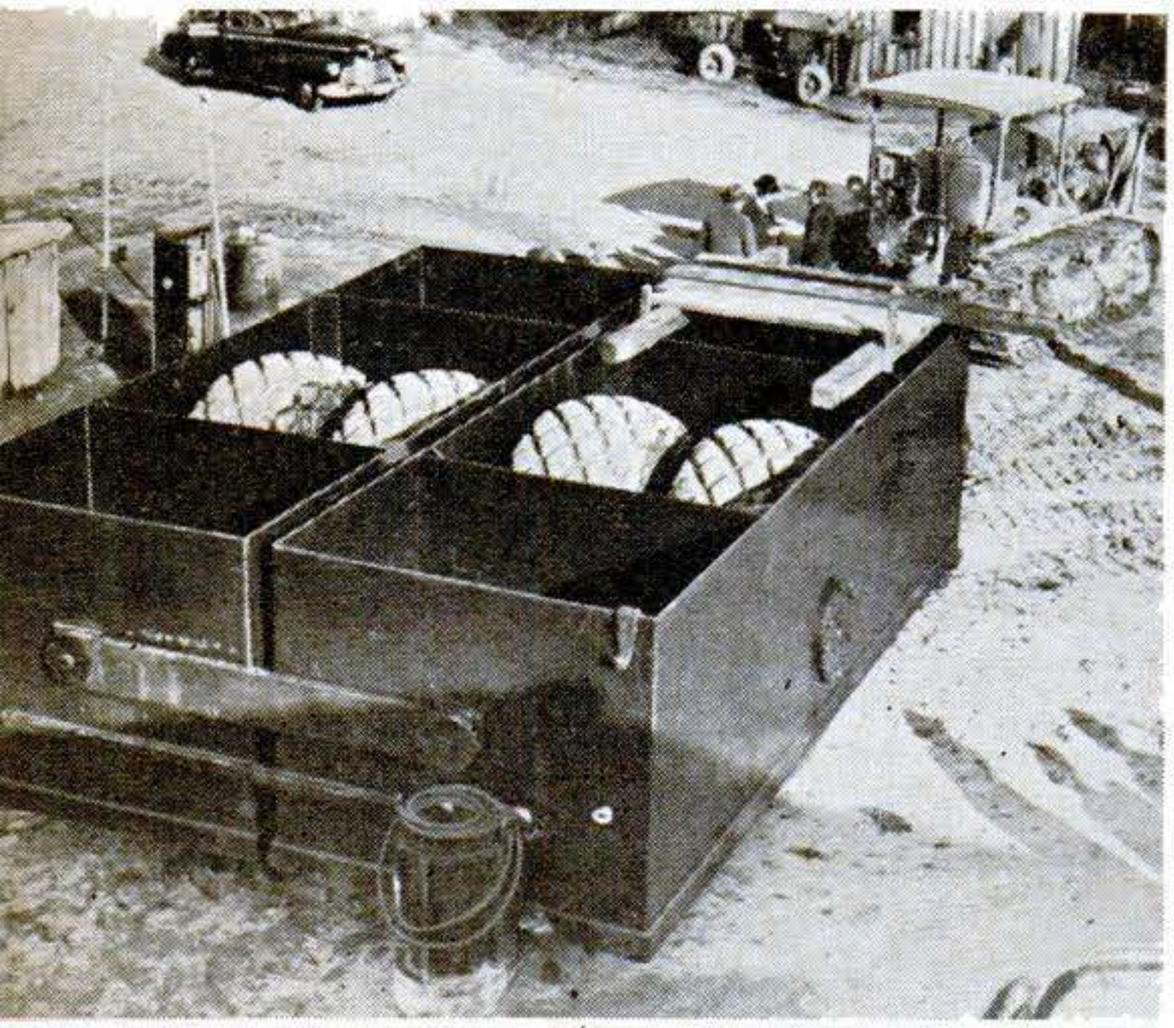
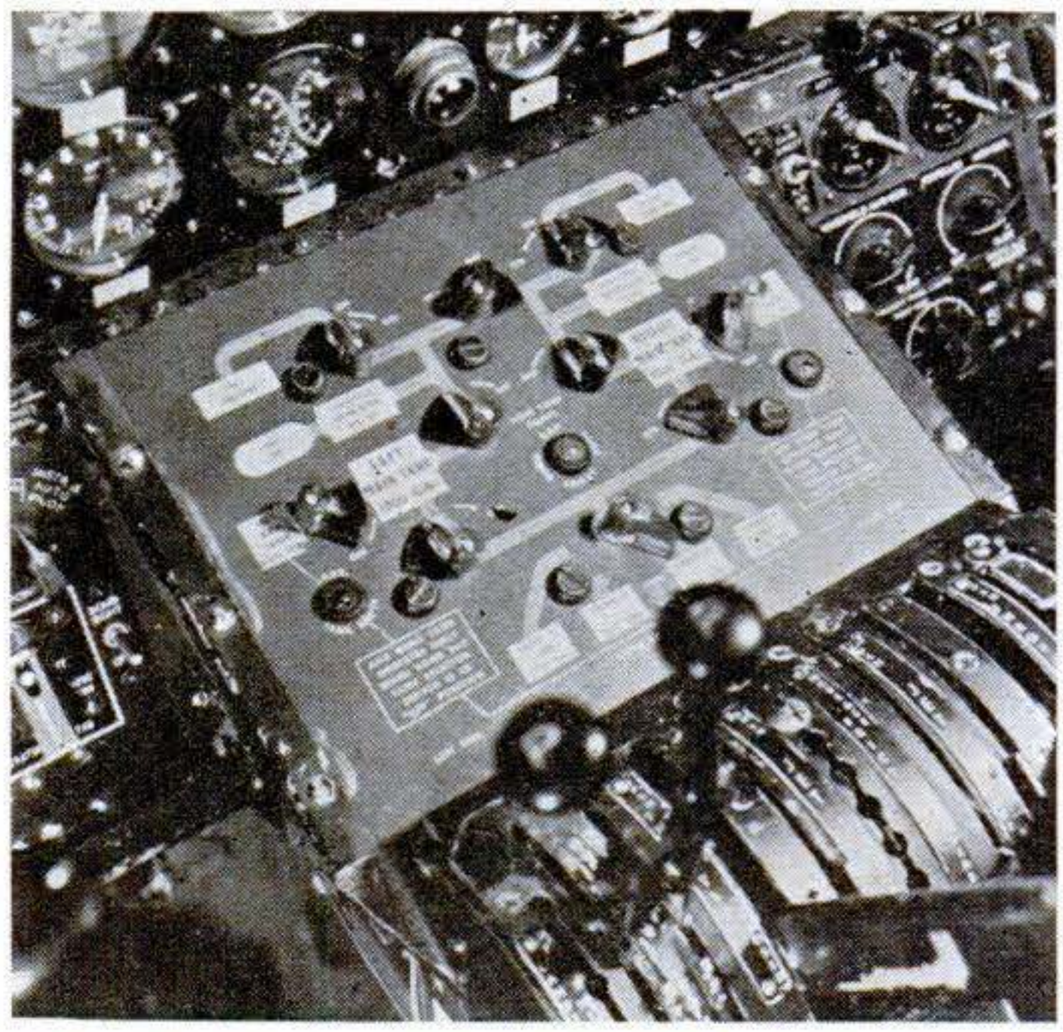
What's New in Aviation

Visibility Increased. Two windows on top of the cabin plus a rear window make it easy to see out of this 1949 Silvaire Sedan Ⓣ even though it is a high-wing plane. The new Luscombe four-seater also features a luxurious interior, with individual cigarette lighters, ash trays, and fresh-air ventilators. Powered by a 165-hp. Continental engine, the plane has a top speed of 140 m.p.h., and climbs 900 ft. a minute.



Huge Tires Pack Soil. A solidly packed base is needed to build runways that will take the impact of heavily loaded aircraft. The packing can be done now with the Super-Compactor Ⓣ shown above. When the corner compartments are filled with ballast, the four big boxed-in tires exert a total pressure of 400,000 lb. Cylindrical attachment in right foreground is a hydraulic jack for testing the strength of the packed soil. The unit is manufactured by O. J. Porter and Co., of Sacramento, Calif.



Fuel Flow Is Visible. With gas feeding from eight tanks into four engines, pilots of the Martin P4M Mercator now have an instant picture of what's going on at all times. They see it in the illuminated fuel panel shown above, made of transparent plastic. Mounted directly ahead of the throttles, it gives each pilot a clear view of which tanks are feeding which engines. The Mercator is the newest of the Navy's land-based patrol planes, and has a reciprocating and a jet engine in each of its two nacelles.

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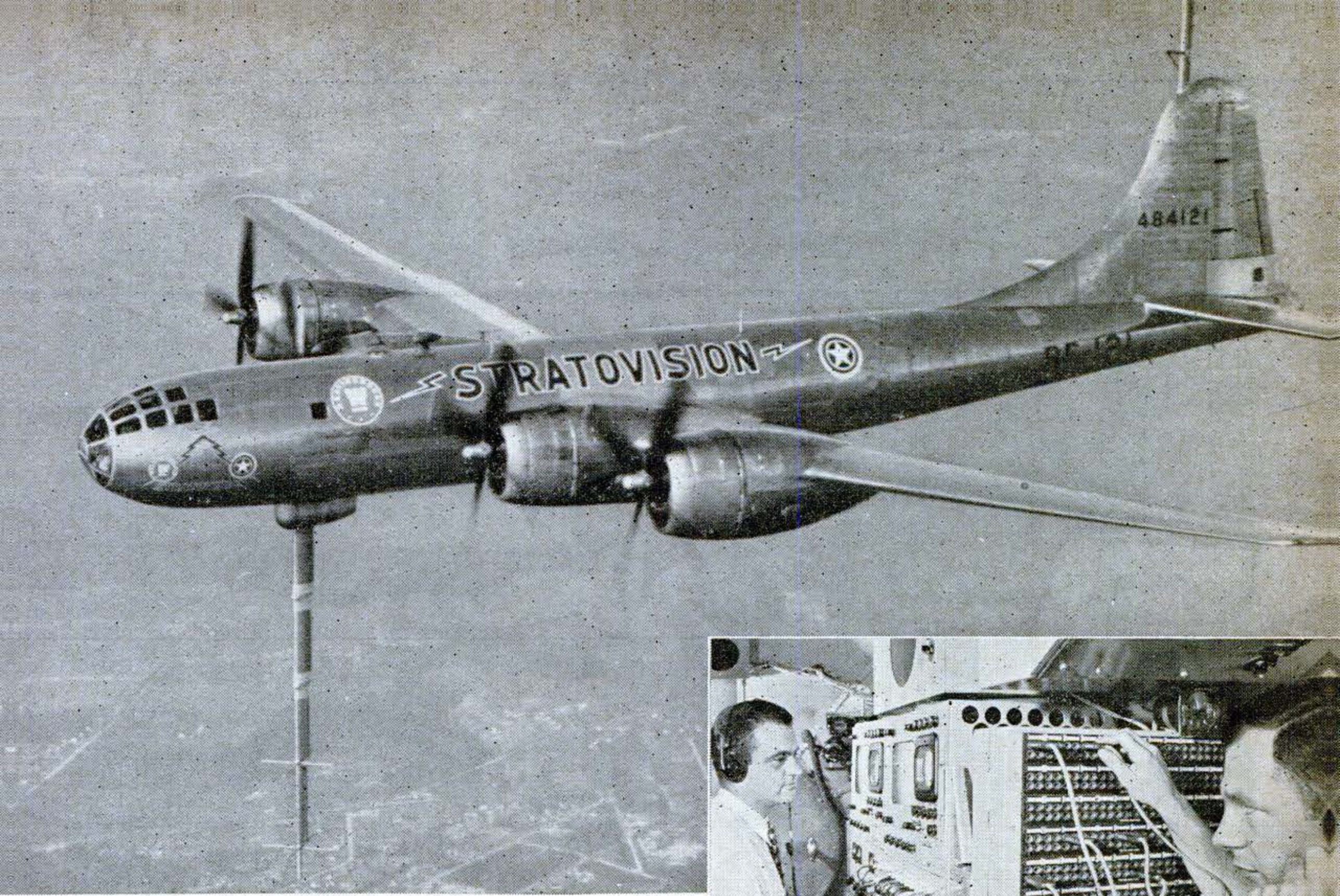

Television From the Sky. Inside a modified B-29 flying at 25,000 feet, engineers (right) are shown monitoring the first public demonstration of Stratovision Ⓣ near Pittsburgh, Pa. The program televised was picked up from an East Coast network by the antenna sticking up above the tail of the plane and rebroadcast from the long, mast-like antenna projecting below the nose. Flying lazily in the sky, the plane transmitted over an area more than 500 miles in diameter—about ten times the range of a ground station. Westinghouse and Glenn Martin engineers, who developed Stratovision, claim that 14 such aerial stations could span the nation with television programs.

British Bantam Takes Off. Weighing about as much as a motorcycle, the 430-pound Fairey Junior shown above does 35 miles to the British gallon. Carrying 11 gallons of fuel, it can fly non-stop from London to Paris at a cruising speed of 66 m.p.h. Recently demonstrated, the tiny one-seater is expected to sell in England for $2,000.

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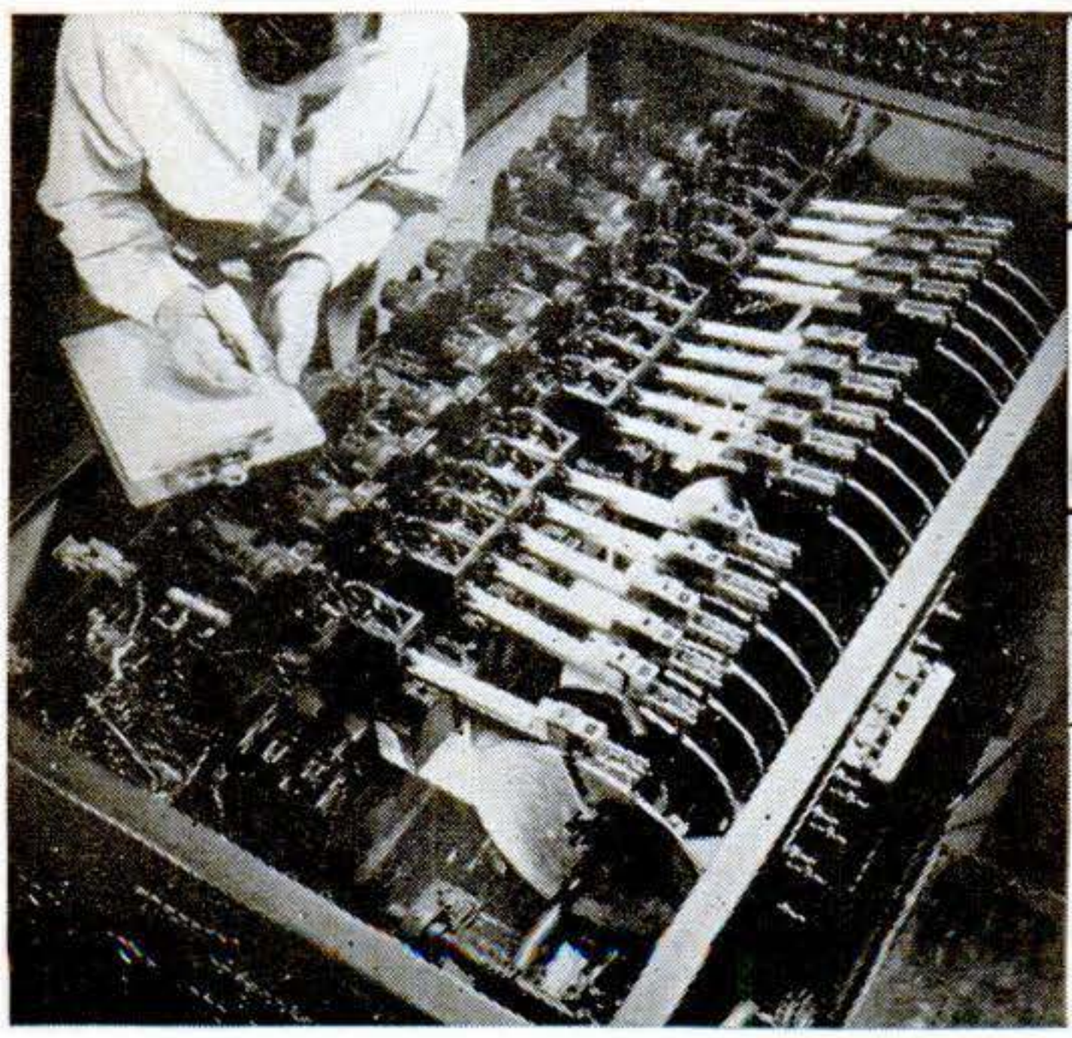
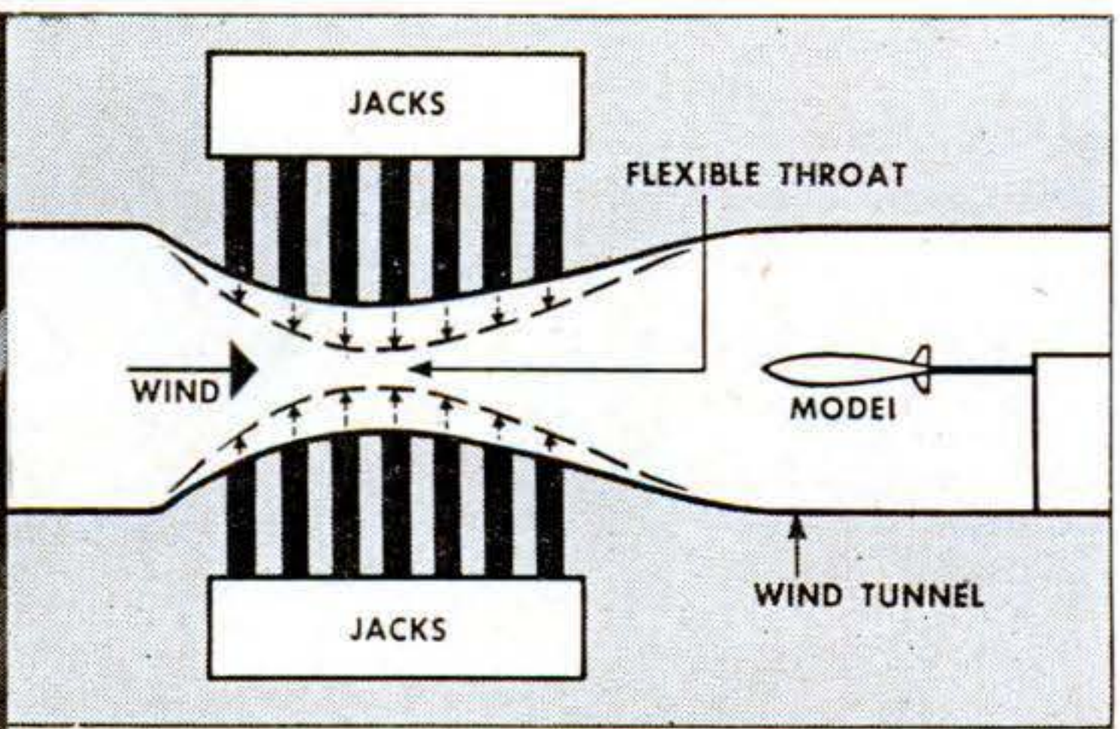
Mechanical Throat Makes Wind Blow 3,000 M.P.H.

Test model of a guided missile is placed inside flexible-throated, supersonic wind tunnel. Air squeezed through throat will smash past model at velocities up to four times the speed of sound.

THE Army's newest wind tunnel has a throat as flexible as your own. As a result, it can reproduce any air speed up to four times that of sound at the touch of a couple of push buttons. With it, engineers can test models of supersonic aircraft and guided missiles at continually varying velocities without stopping to change from one fixed throat to another.

The throat is the vital part of the tunnel, since high air speeds are obtained by suddenly squeezing the air through the narrow opening, forcing it to speed up. In the new tunnel, installed at the Army's Aberdeen (Md.) Proving Ground, the throat consists of flexible steel plates. When jacks press inward on these plates, they can squeeze the opening down to ¾ in. The resulting air velocity approaches 3,000 m.p.h.—an all-time high for any large, continuous-operation wind tunnel. The jacks can be adjusted for any lower speed desired.





Adjustable throat, shown in diagram above, is controlled by two sets of jacks that press inward on flexible metal sections in top and bottom of tunnel, varying throat opening. Intricate cam system, at left, operates jacks, regulates throat to within .001 in. of desired size.

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Your Next Tire May Be a "Lucky Wonder"?

Is this the "jackpot" tire with the better-than-natural rubber? Since they are being sold unmarked, getting one will depend on your luck—until makers can meet the demand for more.

Three out of a hundred 1948 buyers will get a masked marvel with invisible extra mileage built in.

By Charles Stevenson and Alden P. Armagnac

IF Lady Luck is smiling your way, the next time you buy a tire for your car, you'll get more than you expected for your money. This year, something like three out of 100 purchasers are going to receive a surprise-package tire, and the next one may be you.

This mystery tire will be of a standard make and will bear no distinguishing label. Its black rubber looks exactly like that of any other synthetic-rubber tire in the shop. Neither you nor the dealer can tell it from the rest—not even an expert could. So, if you walk out with the jackpot tire, you won't even know it until some day—perhaps in 1950 or 1951—you realize it has worn longer than any tire you have ever owned. Its invisible extra mileage is the maker's gift to the lucky buyer.

Just reaching the market, the wonder tires are the first to employ a brand-new kind of synthetic rubber, called "cold rubber" because it is made in refrigerated kettles. In at least one application—the treads of passenger-car tires, where it is being used at present—the new rubber surpasses nature's best.

Laboratory tests and high-speed road trials indicate that the new tires should give up to 30 percent more mileage than tires of the finest natural rubber. Some of the new type have run 40,000 miles on test cars without even wearing smooth. There seems no doubt that they are the finest tires the world has ever known.

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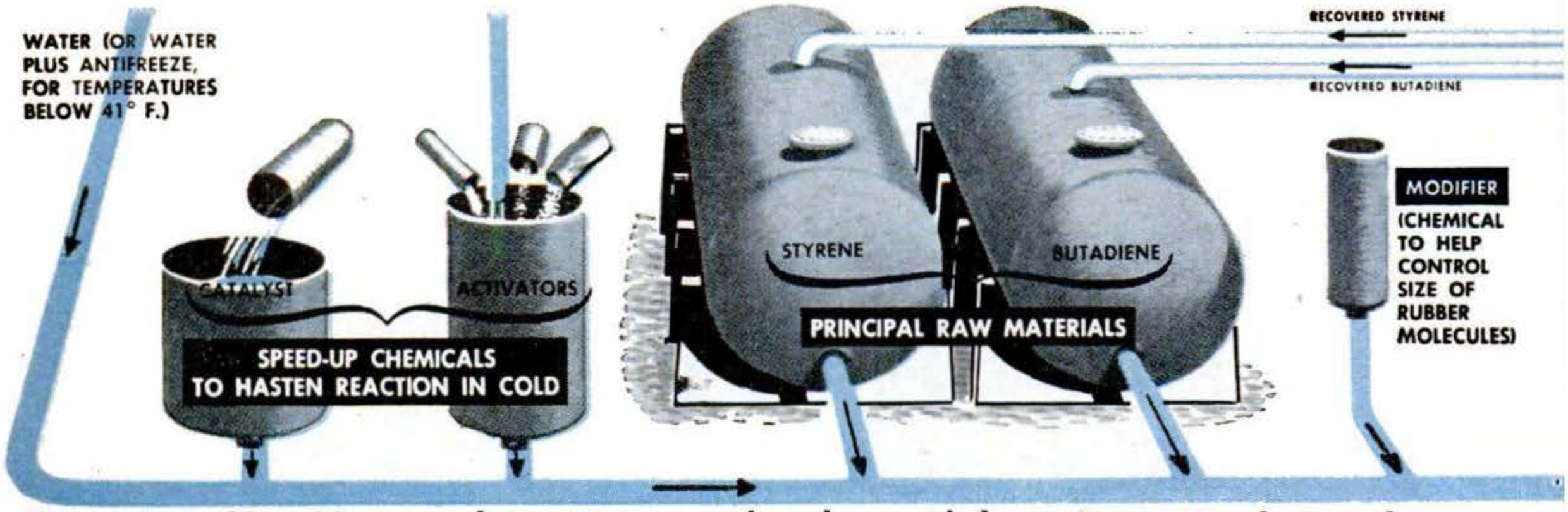

To make cold rubber, novel process uses speed-up chemicals and refrigerated kettles. Simplified pictorial diagram, continued on next three pages, and accompanying photographs show the way it's done at Borger, Tex., by United States Rubber Company. Samples drawn off from kettle (photo inset) tell when the rubber-making reaction has reached the desired stage.

The special synthetic rubber that goes into these tires is not expensive. About four cents a pound cheaper than natural rubber, it sells at the same price as ordinary synthetic rubber, 18½ cents a pound.

Large-scale manufacture of cold rubber, which climaxes years of effort to surpass nature's kind, started only a few months ago. The Copolymer Corporation began making it last February at Baton Rouge, La., and the United States Rubber Company last April at Borger, Tex., in synthetic-rubber plants that they operate for the Government. These two plants produce the entire current supply, now approaching 3,000,000 pounds monthly. Meeting only a fraction of the demand so far, the output will rise as other synthetic-rubber plants convert to the new process. By the end of this year the Goodyear Tire and Rubber Company will be making cold rubber at Los Angeles, Calif., and the United States Rubber Company will have a second plant in operation, at Naugatuck, Conn.

Sugar now goes into rubber. Above, a worker makes up a solution of dextrose sugar, one of the four speed-up chemicals in the newly discovered recipe that makes cold rubber feasible.

Factories are making tires out of the new rubber as fast as shipments are received. The United States Rubber Company's cold rubber from Borger goes to its main tire plant at Detroit, Mich. Copolymer's cold rubber from Baton Rouge, shipped to factories dotting the map from Connecticut to Colorado, supplies a group of eight participating tire companies, in which Sears Roebuck has the largest interest.

Put yourself in a tire maker's place and you can see why cold-rubber tires aren't yet being advertised. There simply aren't enough, so far, to go around. And talking about them would just make it harder to sell the regular kind that most buyers must be content to get for awhile. Next year, with more cold rubber available, production of the tires containing it will soar. At some future time, if they fulfill all expectations, they will probably become standard.

Cold-rubber tires sold to motorists meanwhile will provide a final mass test of the new material. As one tire maker explains, nothing but actual use by the public can reveal the frequency with which an occasional tire—perhaps less than one out of 100—will prove defective after long service. Makers learn of these rare cases when a purchaser brings back a tire to the dealer with a complaint. By the serial number that the tire bears, the maker will be able to distinguish the new kind from the regular

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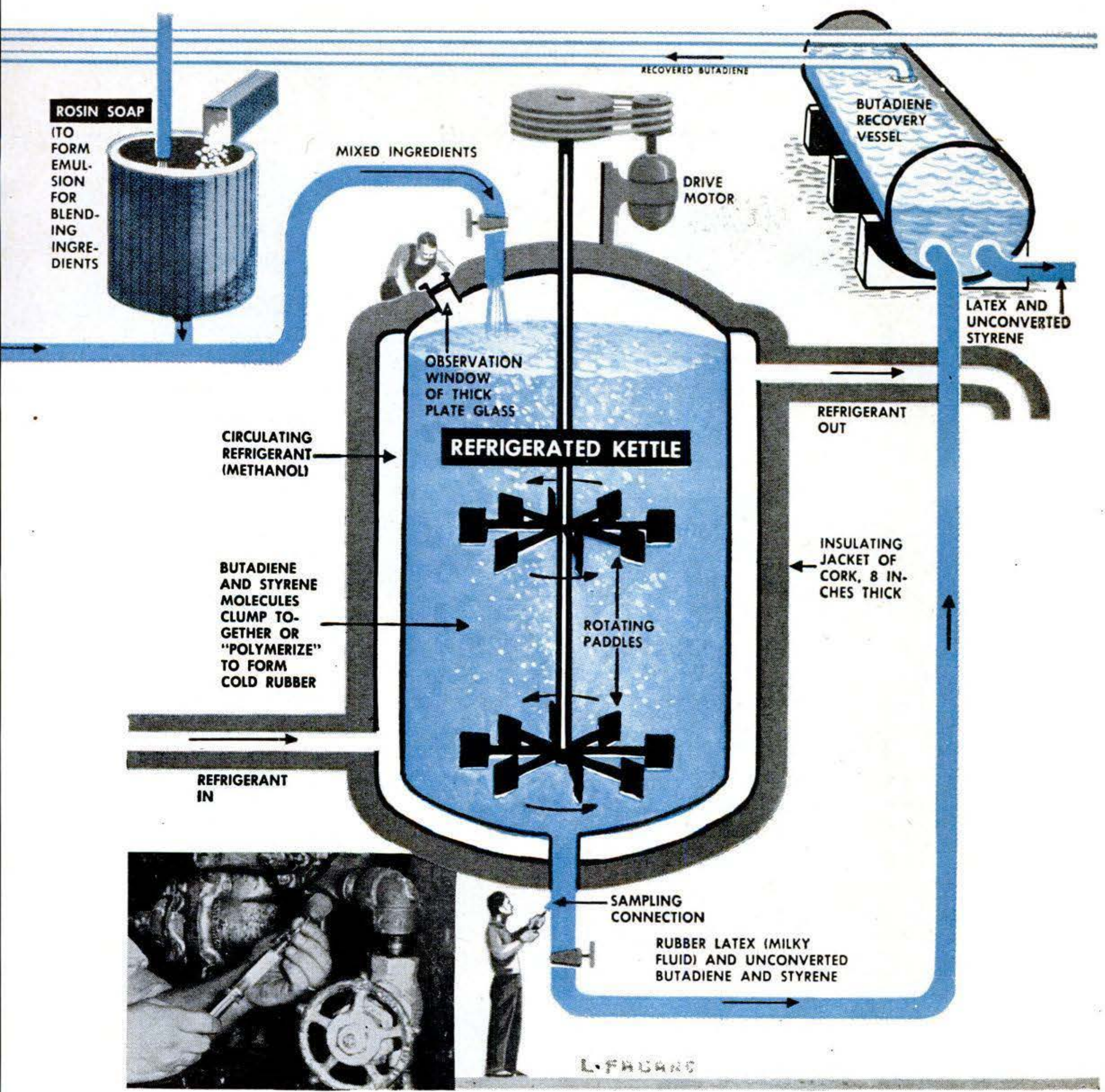

type. And if users complain of fewer defective tires among the new type than the old, in proportion to the number sold, this will provide the final proof of the new kind's superiority on all counts.

Tires currently being made of the new rubber are of composite construction. The tread is of cold rubber, and the rest of other types. Experiments in adapting cold rubber to tire carcasses are under way.

Even if tire makers can employ the new rubber only in treads, a vast market awaits it—for tire-tread rubber amounts to about a third of the nation's entire rubber consumption. The price of natural rubber will have little to do with this outlook. The tread of the average tire weighs 4½ pounds. If plantation rubber dropped to ten cents and cold rubber held at 18½ cents a pound, the synthetic tread would cost only 38¼ cents more than the natural—not much to pay for an extra 10,000 miles.

And when the supply of cold rubber becomes plentiful enough, much wider applications are foreseen. It may well prove a superior material for rubber soles, rubber heels, insulation for electric wire, and foam-rubber mattresses and upholstery cushions.

Not only motorists and other immediate users, but every American citizen, will

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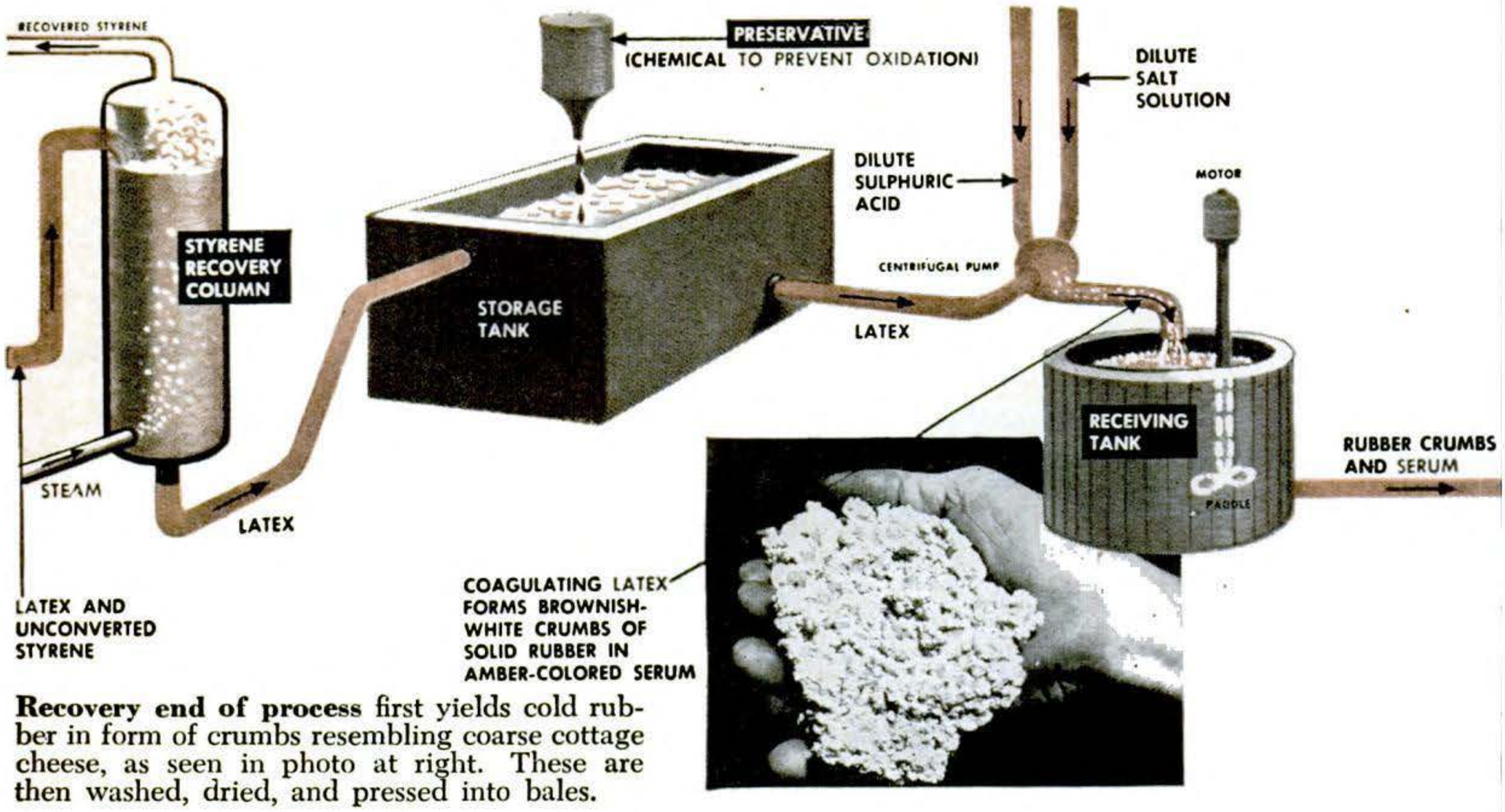
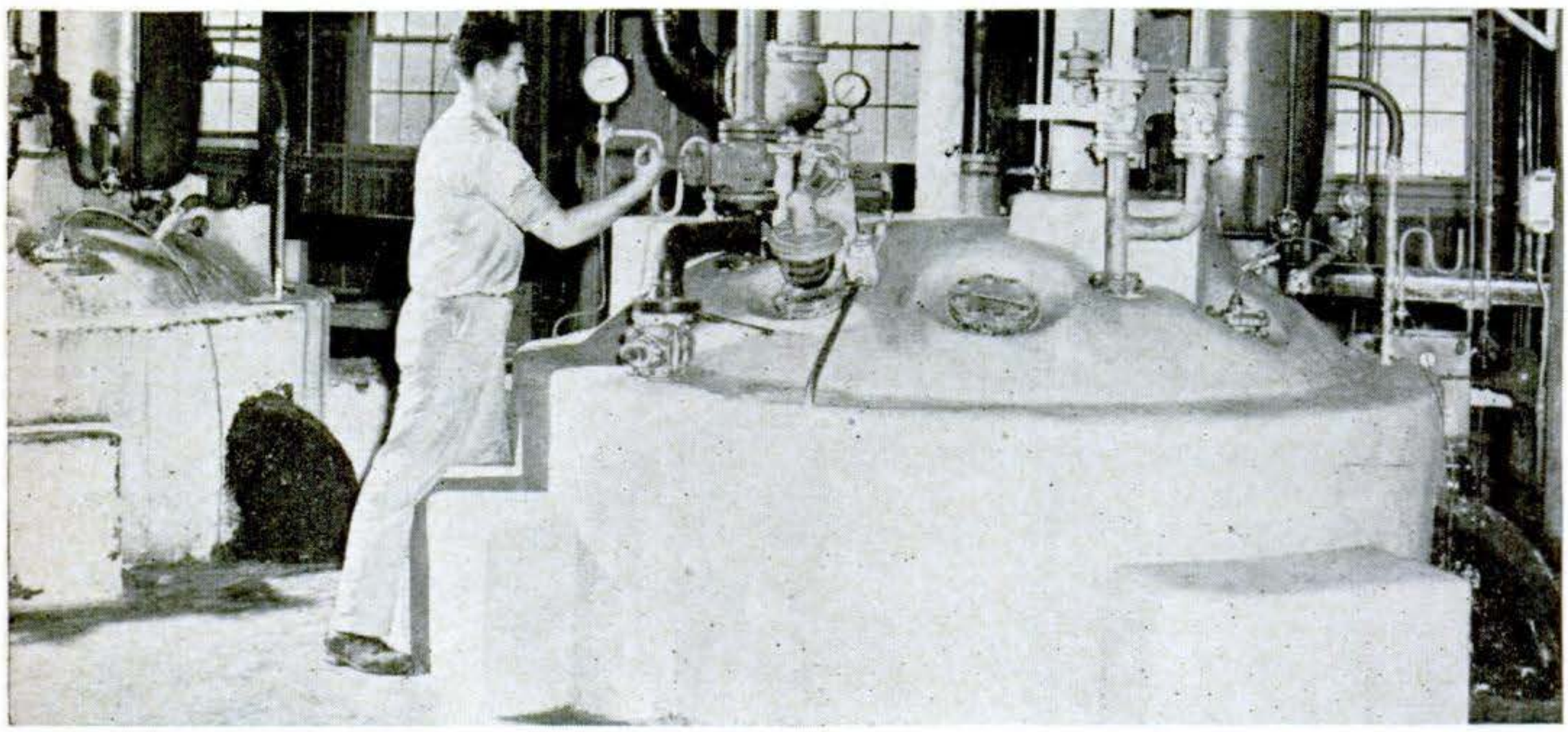


Recovery end of process first yields cold rubber in form of crumbs resembling coarse cottage cheese, as seen in photo at right. These are then washed, dried, and pressed into bales.

benefit from a material superior to natural rubber and in such universal demand. For it will breathe new life into the synthetic-rubber industry, vital to national defense.

When World War II cut us off from Far East rubber, we had to build from scratch the gigantic $700,000,000 synthetic-rubber production line that kept our trucks rolling, our planes flying, and our guns in action. War's end faced it with the prospect of becoming an ugly duckling. To keep this great industry geared up to meet a possible future emergency, it has had to have Government support—including legislation requiring makers of rubber goods to use a specified percentage of synthetic rubber—and has been at the mercy of prevailing opinion on Capitol Hill.

At one stroke, cold rubber now lifts this strategic industry out of the realm of politics and transforms it into an independent and booming commercial enterprise. Now it can stand on its own feet, assured of a permanent future in its own right. Another fleet of battleships could hardly be a greater asset to our national security.



Three refrigerated kettles like this one, something **new in rubber making, produce** the phenomenally long-wearing cold rubber in the Borger plant at temperatures from 41° down to 0° F.

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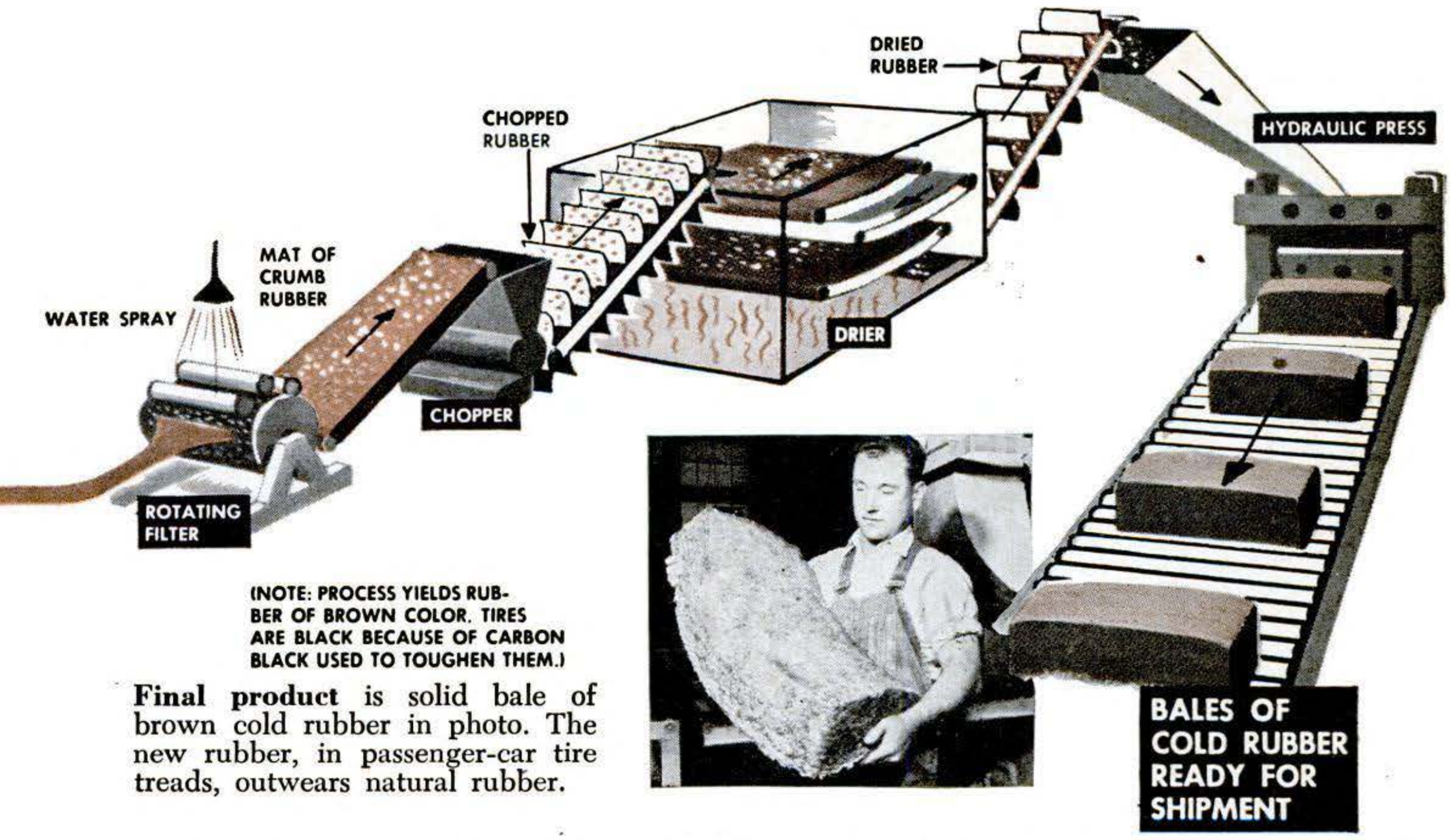

(NOTE: PROCESS YIELDS RUBBER OF BROWN COLOR. TIRES ARE BLACK BECAUSE OF CARBON BLACK USED TO TOUGHEN THEM.)

Final product is solid bale of brown cold rubber in photo. The new rubber, in passenger-car tire treads, outwears natural rubber.

Like the synthetic rubber of World War II, cold rubber results from the teamwork of all the leaders of the industry—pooling information and working closely together.

Best all-around wartime synthetic rubber, and the immediate ancestor of the new low-temperature kind, was GR-S—short for "Government rubber, styrene type." It used the same two principal raw materials, butadiene and styrene, that cold rubber does. Butadiene is a gas, derived from petroleum or alcohol, which can be compressed to form a volatile water-white liquid. Styrene is a colorless liquid obtained from coal or natural gas. When these ingredients and supplementary chemicals are churned together in a kettle, under pressure and at a constant temperature, a reaction called polymerization takes place. Little molecules clump together to make big ones—and the product is synthetic rubber.

Working desperately against time, wartime researchers found they could make this reaction go fast enough to suit them at 122° Fahrenheit. (This was the equivalent of a round figure of 50° on their laboratory-type Centigrade thermometers.) The GR-S that resulted was good enough to meet the emergency. Without further ado, they standardized on that method and succeeded in turning out more than a million long tons of rubber a year. All the rubber trees in the world produced only a little over a million and a half tons in their best year.

GR-S gives about 70 percent of the mileage of the best natural rubber, in passenger-car tire treads. Better synthetic rubber would result, experts have known, if they ran the rubber-making kettles at a considerably lower temperature than 122° F.—say, 41° F. (equivalent to 5° Centigrade). But this was out for wartime purposes, because it was found to slow down the reaction time from 12 hours to several days; and the same drawback appeared to make the low-temperature process uneconomical for peacetime use. A given number of kettles would turn out only a fraction as much 41° GR-S as 122° GR-S.

Key to large-scale production of low-temperature rubber is a recently discovered recipe using four speed-up chemicals, which make the reaction take place many times faster in the cold. They are cumene hydroperoxide, dextrose sugar, sodium pyrophosphate, and ferrous sulphate. Successfully tried out for rubber making by University of Minnesota experimenters in 1946, cumene hydroperoxide is a new chemical product, made at Brunswick, Georgia, by the Hercules Powder Company and supplied in 55-gallon steel drums as a pale yellow to colorless liquid. It acts as a catalyst for the synthetic-rubber reaction —replacing potassium persulphate, the agent formerly used for GR-S. The other three chemicals are activators that abet the action of the new catalyst. When these

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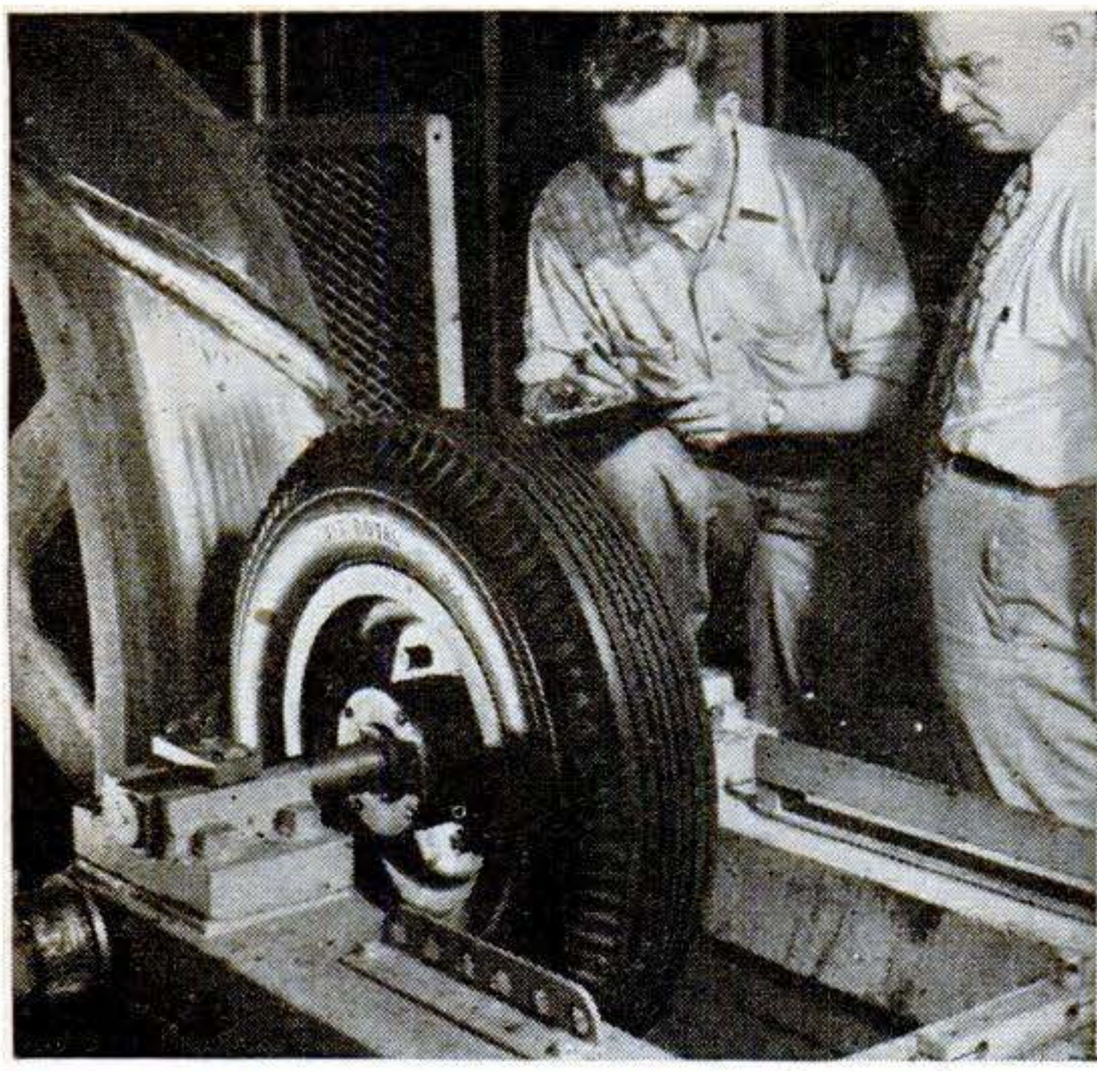

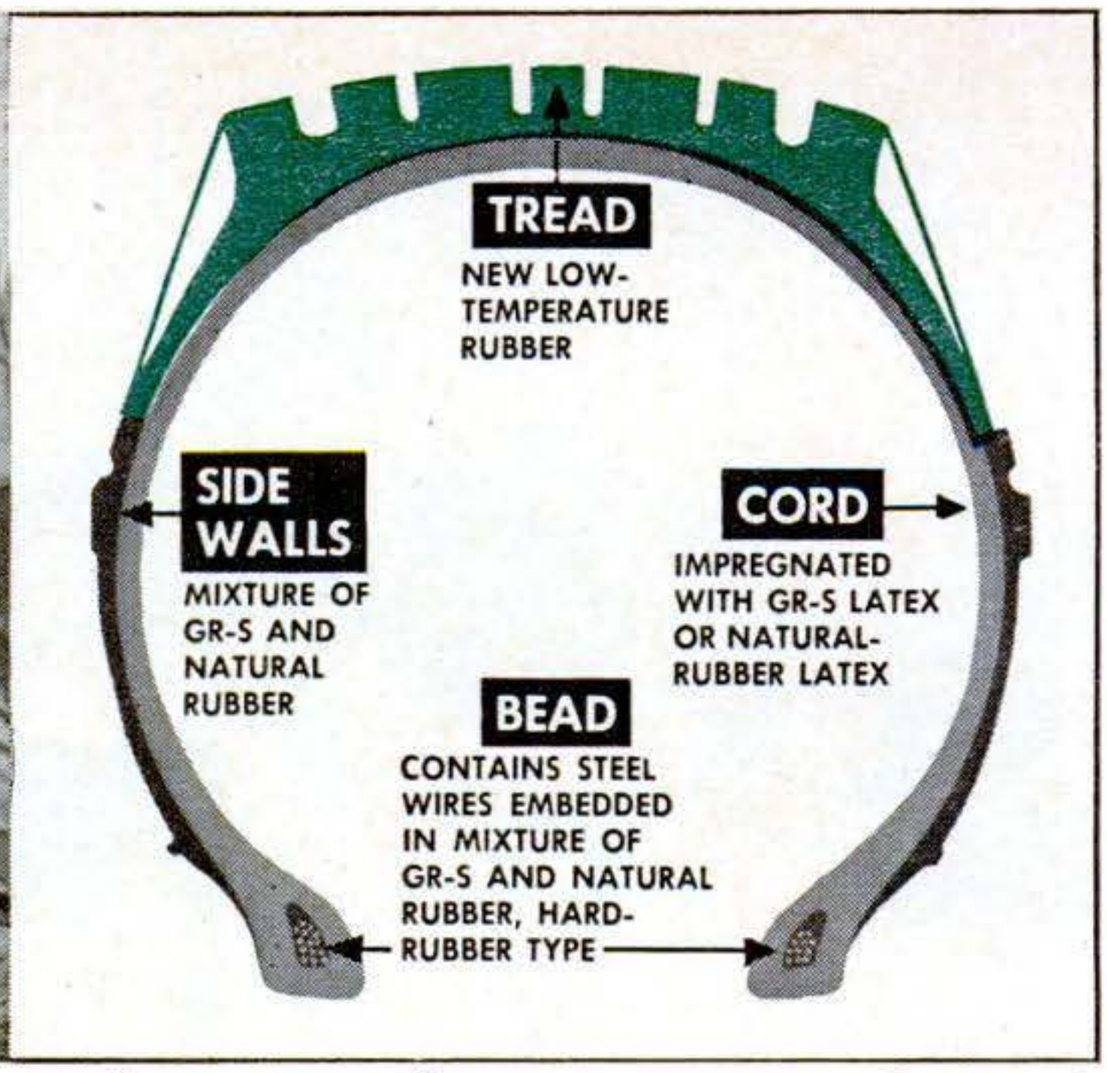

Here is the wonder tire. Actual photo of one, under test, shows wheel that simulates bumpy road. Diagram illustrates composite design of the new tire, which uses cold rubber for tread.

speed-up chemicals are added to a kettleful of raw materials, rubber can be made in 12 hours at 41° F., just as quickly as by the old process at 122° F. It shows all the superior characteristics typical of low-temperature rubber—better resistance to wear and cracking, higher tensile strength—which, chemists say, are due to a more desirable size and composition of the molecules.

Equipment never seen before in the rubber industry applies the 41° F. process at the Borger and Baton Rouge plants. Banks of cork-jacketed kettles, cooled with circulating refrigerant from frost-coated pipes, chill their contents to the temperature of a snappy March morning. Within, butadiene and styrene look at first like droplets of oil in salad dressing as they and supplementary chemicals are blended in an emulsion, with the aid of soapy water. As their molecules fuse into larger ones, they form a milky fluid or latex, like that which oozes from the rubber tree. Samples drawn off at intervals show how the reaction is progressing and indicate the right moment at which to drain off the latex, into tanks where it is coagulated into brownish-white rubber crumbs resembling coarse cottage cheese. These are washed, dried, and pressed into bales of solid brown rubber. The entire operation is automatic.

If this low-temperature rubber were toughened with ordinary carbon black, a form of lampblack widely used for the purpose, it would wear half again as long as GR-S and its quality would just about equal that of natural rubber. The additional improvement that gives the new synthetic its marked superiority over natural rubber comes from an improved type of carbon black, developed in research pioneered by the Phillips Petroleum Corporation. Called "furnace black," this new ingredient benefits other synthetic rubber too, but with low-temperature rubber its effect is particularly favorable. The happy combination of cold rubber and improved carbon black produces the finest synthetic rubber ever made.

And chemists may do better yet—for, as they point out, the quality of rubber from trees is fixed by nature, while that of synthetic rubber is limited only by man's ingenuity. Investigating the most promising possibility, the United States Rubber Company has just begun large-scale production of cold rubber at 14° F. and 0° F., as well as at 41° F., in its Borger plant. Antifreeze, substituted for part of the water in the reaction kettles, keeps the contents from freezing solid at these extremely low temperatures and is later recovered. Preliminary experiments at a cold-rubber pilot plant of the Phillips concern have yielded a progressively tougher rubber, at a few cents more per pound, as the temperature is dropped to 14°. And Phillips' assistant chief of research, W. A. Schulze, predicts that 75,000-mile tires can be made in the near future. Whether these materialize will depend upon motorists' willingness to pay for premium quality. END

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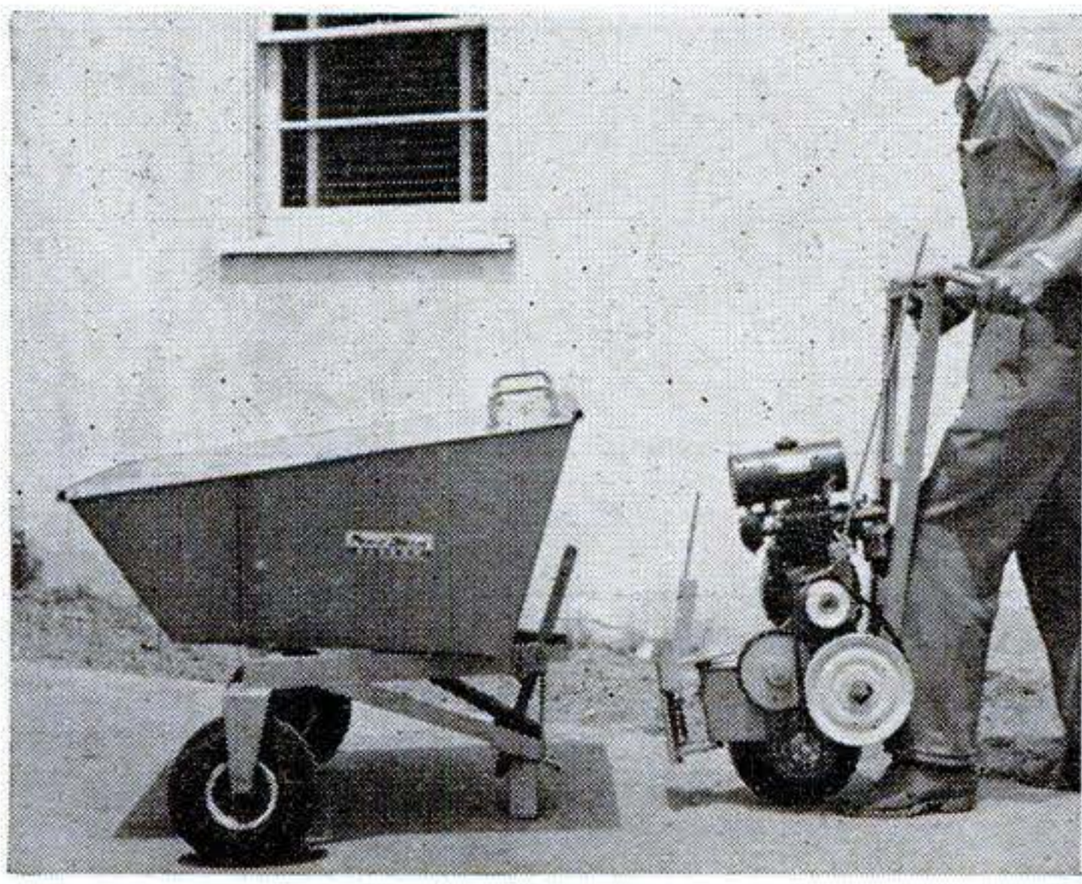
"Train" Rides Road

You have to look twice at the giant Foster trailer truck above to make sure it's not a freight train. It's 60 feet long and can haul a 50-ton load—more than the average railroad box car. For easy loading, the rear of the trailer tilts down, forming a ramp (right). As the load mounts the ramp, the bed presses down on the rear wheels, providing added brake friction and permitting loading on a slight grade. Truck and trailer can be drawn up flush so loads can roll directly from the trailer bed onto the truck bed.



Wheel Does Many Jobs

Just hook this single-wheeled, handle-bar Pow-r-Wheel Ⓣ onto the dump barrow at left above, and you have a power barrow. Detach the barrow body from its two-wheeled chassis, put on the flat body at right above, and you now have a flat-bed truck for hauling cans or crates. The single-cylinder, 1½-hp. driving wheel provides speeds up to 3¼ m.p.h., can push a full 600-lb. load up a 30-percent grade and turn in a 27-in. radius. A 2½-hp. model handles 400 lb. more. Made by the C. G. Schulze Co., of Los Angeles, the machines can also be used with sweeper and mower attachments.

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The Boeing Stratocruiser Ⓣ cousin to the famed atom-bombing B-29 and its new big brother, the B-50, is scheduled to begin commercial air-line service next year. The big plane —110 ft. 4 in. long, its wings spreading 141 ft. 3 in. tip to tip—can carry up to 114 passengers.

Vertical tail surface, towering as high as a three-story building, can be folded down to one side (as shown below) to let the Stratocruiser into a hangar. Men walking upright under an outboard engine nacelle give another suggestion of the new sky queen's great size.

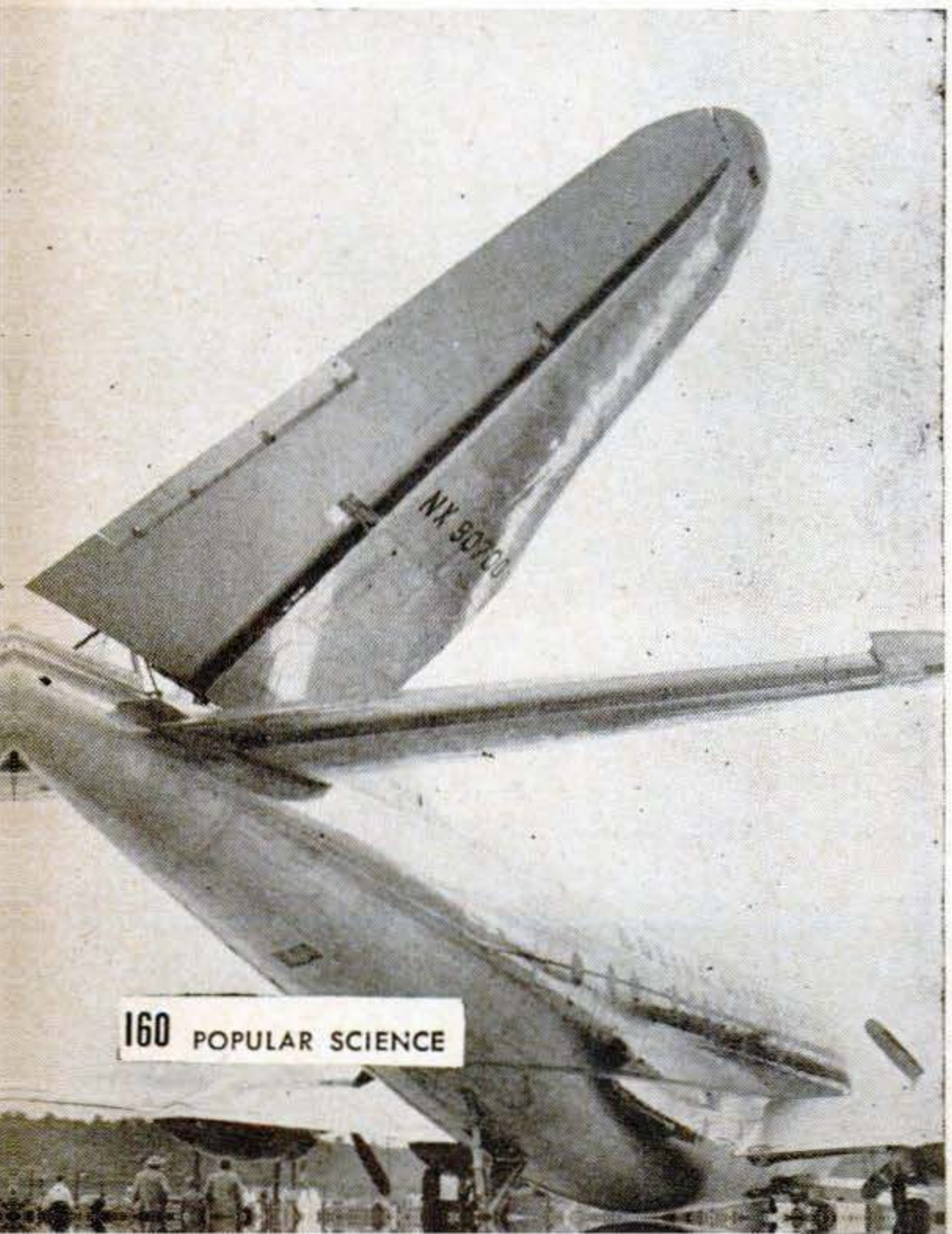


Figure 8 contour of the fuselage, when viewed head on, shows the Stratocruiser's ancestry. Its upper deck has been added, in effect, to the circular fuselage of the B-29. Boeing's Stratofreighter Ⓣ, the cargo-carrying C-97, has much the same cross-section as the new air liner.

Your First Trip In a Stratocruiser

Your pilot on the two-decker will be a veteran, but there'll be many surprises for you as a passenger.

By George H. Waltz, Jr.

IT had been quite a flight. All that remained was for us to grope our way down through thick weather to an instrument landing at New York's LaGuardia Field. Rough air had messed up our first approach, and we had gone around for another try.

"Landing gear down," called the pilot.

"Landing gear down and locked," came the co-pilot's response.

"Full flaps," ordered the pilot.

"Full flaps," echoed the co-pilot, after checking the flap-position indicator on the instrument panel.

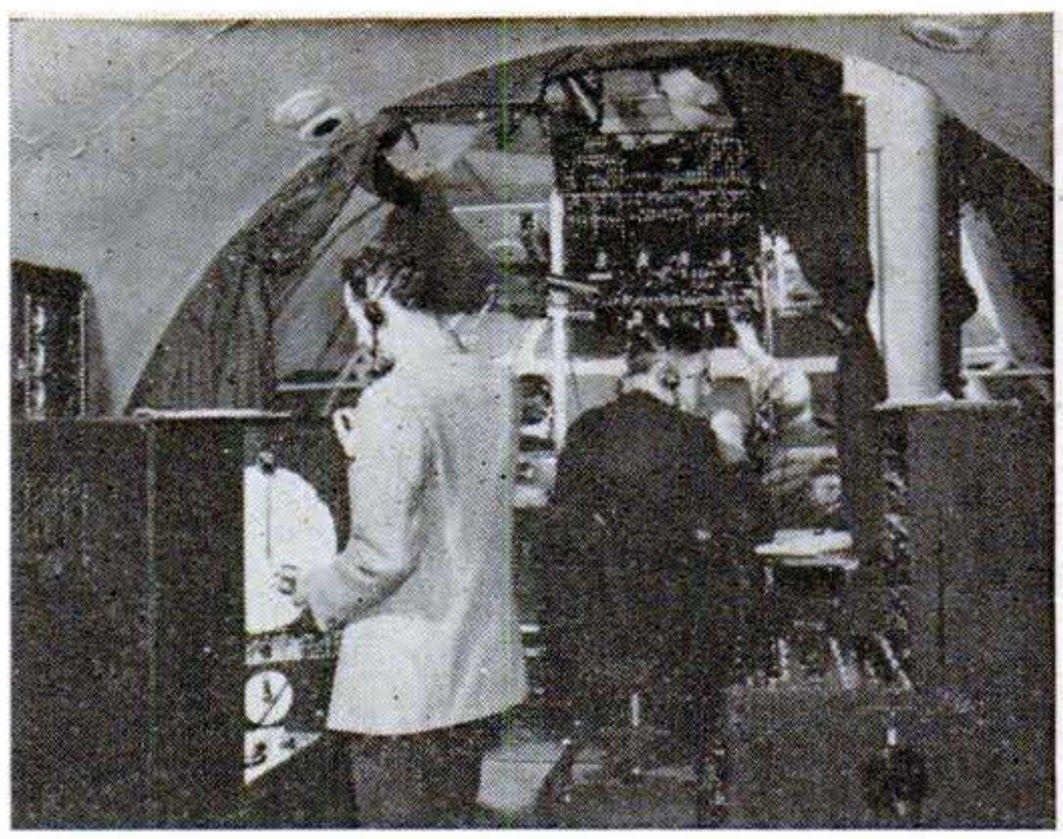
The pilot eased back the throttles, and the roar of the engines settled to a whistling purr. Suddenly I heard the welcome screech of the plane's tires on the runway.

The pilot, co-pilot, and flight engineer at their controls had literally sweated that one out. Their white shirts were spotted with perspiration.

So was mine. This had been my first experience as an observer in the instrument-filled cockpit of a Boeing Stratocruiser®—aviation's newest and biggest passenger plane, which soon will be plying the air routes of six major air lines. We had flown for more than an hour, and just about every-

Four 3,500-hp. engines power the luxury air liner. In landing, blades of all four propellers can be reversed in pitch to serve as brakes and shorten the plane's run after its wheels touch. With blades of its props thus reversed, Stratocruiser can even back itself into a hangar.

Stratocruiser cockpit houses some 600 controls and indicators. Seated here are pilot (left), co-pilot (right), flight engineer (foreground). Plane also carries navigator, radio operator.



Flight simulator for training Stratocruiser crews is duplicate of PAA's cockpit. Instructor at "trouble box" in foreground creates flying problems and checks the trainees' responses.

thing had happened: bad weather, ice on the wings, an engine failure, radio troubles. *And we had completed the flight successfully without ever leaving the ground.*

We had been "flying" the amazing new electronic flight simulator built by Curtiss-Wright. It is used by Pan American Airways to train the crews who will fly a PAA fleet of 20 Stratocruisers.

The flight simulator, which cost $250,000, is an exact duplicate of the Stratocruiser's cockpit. Thanks to an ingenious electronic brain, its instruments and flight controls function just as they do in the actual airplane. Seated in the simulator, a pilot can go through any maneuver he normally would execute in the air—plus a good many he wouldn't dare to try if actually flying the $1,500,000 aircraft.

Trouble Made to Order

By twirling dials and flipping switches, a flight instructor, hidden from the pilot and his crew, can make the simulator duplicate just about any kind of flying problem. Then it is up to the flight crew to correct or meet the trouble and complete the flight. Even engine noises and landing sounds are faithfully reproduced. In fact, no greater tribute could be paid to the simulator's realism than the spots of perspiration on the shirts of old-time pilots when they emerge after a "flight" —even though the earth-bound cockpit is air-conditioned.

After my first "flight" in the simulator, I found out more about the Stratocruiser from PAA and Boeing pilots and engineers. I was particularly interested in the new plane because, during the war, I had spent quite a bit of time in the B-29. In fact, I wrote the AAF's pilot-training manual for it. And I knew that Boeing's latest sky queen was a development of that atom-bomb carrier.

When an airplane just naturally wants to do what the pilot would have it do, flyers call it a "pilot's airplane." The Stratocruiser, I learned, is not only very much a pilot's airplane, but a passenger's airplane and a maintenance man's airplane as well.

Let's climb aboard a Stratocruiser for a transoceanic flight. Inside its main passenger cabin, 74 feet long, you take a softly cushioned seat that is the result of more than 100,000 man-hours of research and design. It automatically fits itself to the contours of your body whether you are long or short, fat or lean.

Unlike most flights that you have taken before, this will be no "sit-down" trip. The Stratocruiser is a double-decked airplane. If you get tired of sitting, a centrally located spiral staircase will lead you below to a spacious lounge much like the club car on the fanciest transcontinental train.

In flight, you will breathe air that has been filtered, deodorized, and warmed or cooled according to the need. Up to 15,000 ft., the air pressure in the cabin will be no less than it was at sea level. Even at 25,000 ft., the altitude at which we will make most of our trip, the cabin pressure will never fall below that ordinarily found at 5,500 ft. Your ears won't pop or your nose plug up.

Now that the last passenger is aboard and they are taxiing our ship out for take-off, let's go up front and have a look at the cockpit and flight deck. A glance at the fuel gauges at the flight engineer's position, just behind

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Main cabin, on the upper deck of a PAA Stratocruiser, will accommodate 61 passengers. Pumps keep interior air at low-altitude pressure even when the plane is flying five miles high.

For night flights 36 of the seats make up as nine double berths. With 25 passengers sitting up in the other seats, main cabin thus will carry 43 on overnight and transoceanic hops.

Even stewardess has a control panel. From desk at rear of main cabin she regulates lights and air conditioning, answers passenger calls, and talks by phone with other members of the crew.

Lounge on lower level seats 14 passengers on short trips, or serves as "club car" on long flights. At one end is a serving bar. Plane also has men's and women's dressing rooms.

Meals, precooked and frozen, are reheated by electricity in galley behind passenger cabin on upper deck. Individual serving trays are passed to stewardess through louvers in door.

Trays fit snugly into rimmed tables that hook to seats at mealtime. Rubber mountings prevent vibration of seats in area of cabin affected by pulsating air blasts from propeller tips.

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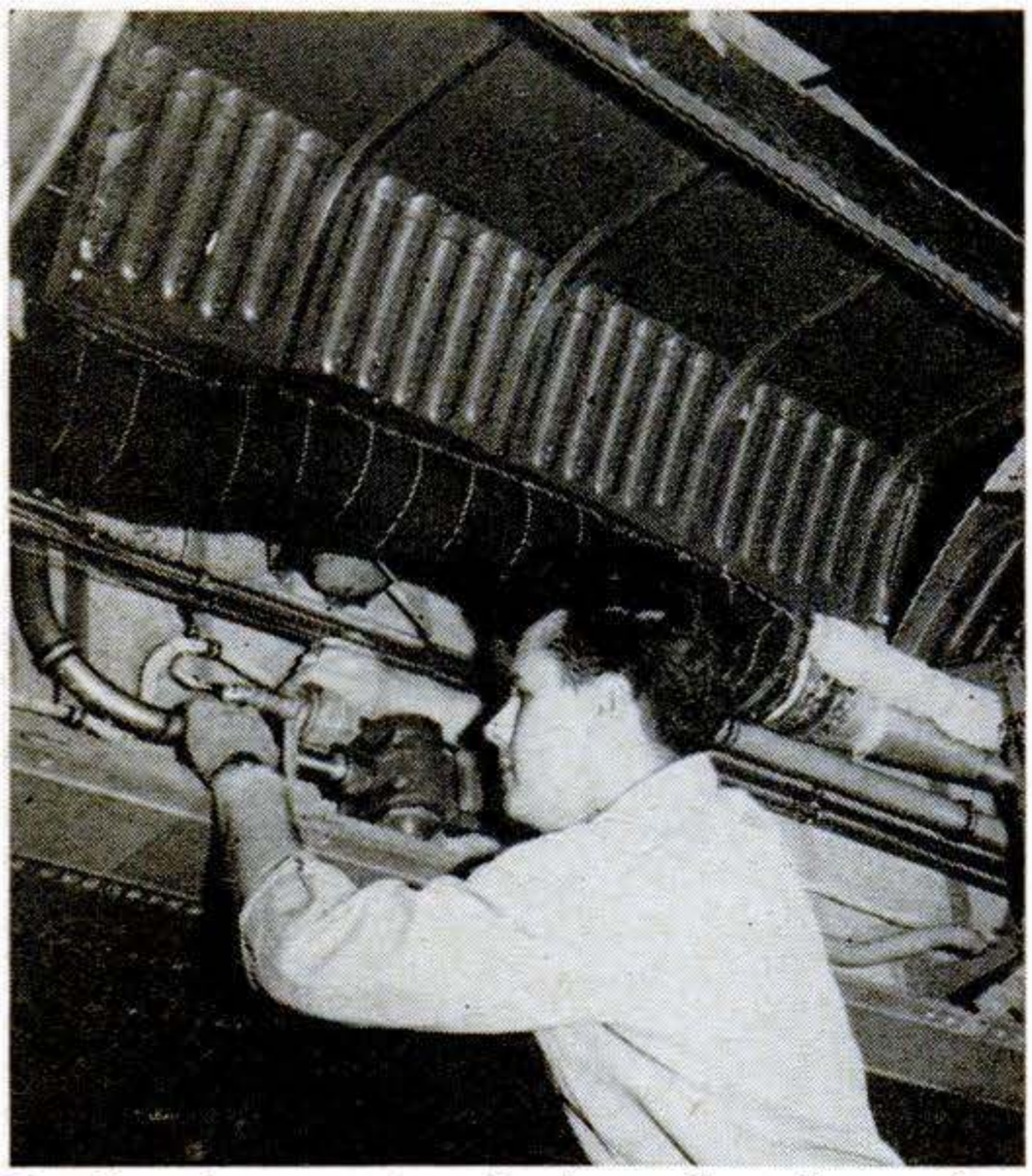

For handy servicing, leading edge of wing between fuselage and engines lifts open on hinges to let mechanic get at heater ducts, oil lines, carbon-dioxide pipes, and electrical wiring.

Built-in stairs permit loading of Stratocruiser without ramps. This one leads to forward cargo compartment. Another in door of aft cargo hold admits passengers through lower-deck lounge.

the pilot and co-pilot, tells us that our Stratocruiser is loaded with 7,630 gallons of fuel. This accounts for about 22½ tons of the big plane's total maximum take-off weight of 70 tons. The oil gauges show a total of 200 gallons of oil.

Now everything is ready for the take-off. As the pilot "walks" his four throttle levers forward, the Stratocruiser's four Wasp Major Ⓣ engines build up to their combined full 14,000 hp.—twice the power of any existing locomotive. The air-speed indicators in front of the pilot and co-pilot show our speed mounting as we roll down the runway. In a matter of seconds we are airborne. The pilot, busy with his flight controls, then calls for "gear up," "flaps up," and finally "normal climbing power." At this last order, the flight engineer adjusts his duplicate throttles and the other engine controls that spread out before him like an organ console, until the engines are delivering the best power for climb.

Cruises Nearly 5 Miles Up

Forty-five minutes later your Stratocruiser has just reached its cruising altitude and the pilots are trimming it for level flight. In that 45 minutes of climb, the Stratocruiser's four engines have used up 700 gallons of fuel to lift you up just about four and three-quarter miles and carry you 182 miles from your starting point. At the moment, the pilot, co-pilot, and flight engineer are adjusting the engine controls to get the most out of their fuel for long-range cruising. For each hour of operation now, your Stratocruiser's engines will use up about 530 gallons of fuel to push you through the air at better than 300 m.p.h.

There is little chance that you will hit any weather during most of your trip. At 25,000 feet you are above the effects of most storms. Besides, your navigator has plotted the plane's course around the weather map's "highs" and "lows" to take advantage of all prevailing tail winds to save fuel (PS, July '46, p. 93).

If an engine develops trouble during your flight, you probably will never know it. The Stratocruiser flies just about as well on three engines as it does on four. As a matter of fact, so good is the Stratocruiser's natural stability, even at full load, that an engine could have failed on take-off without your feeling it.

By this time in your transoceanic flight you have probably noticed that, regardless of the changing outside temperature, the window beside your seat has neither frosted over nor steamed up. It can't. The Stratocruiser's windows are fitted with double panes, and cabin air is forced between the panes to keep them at cabin temperature.

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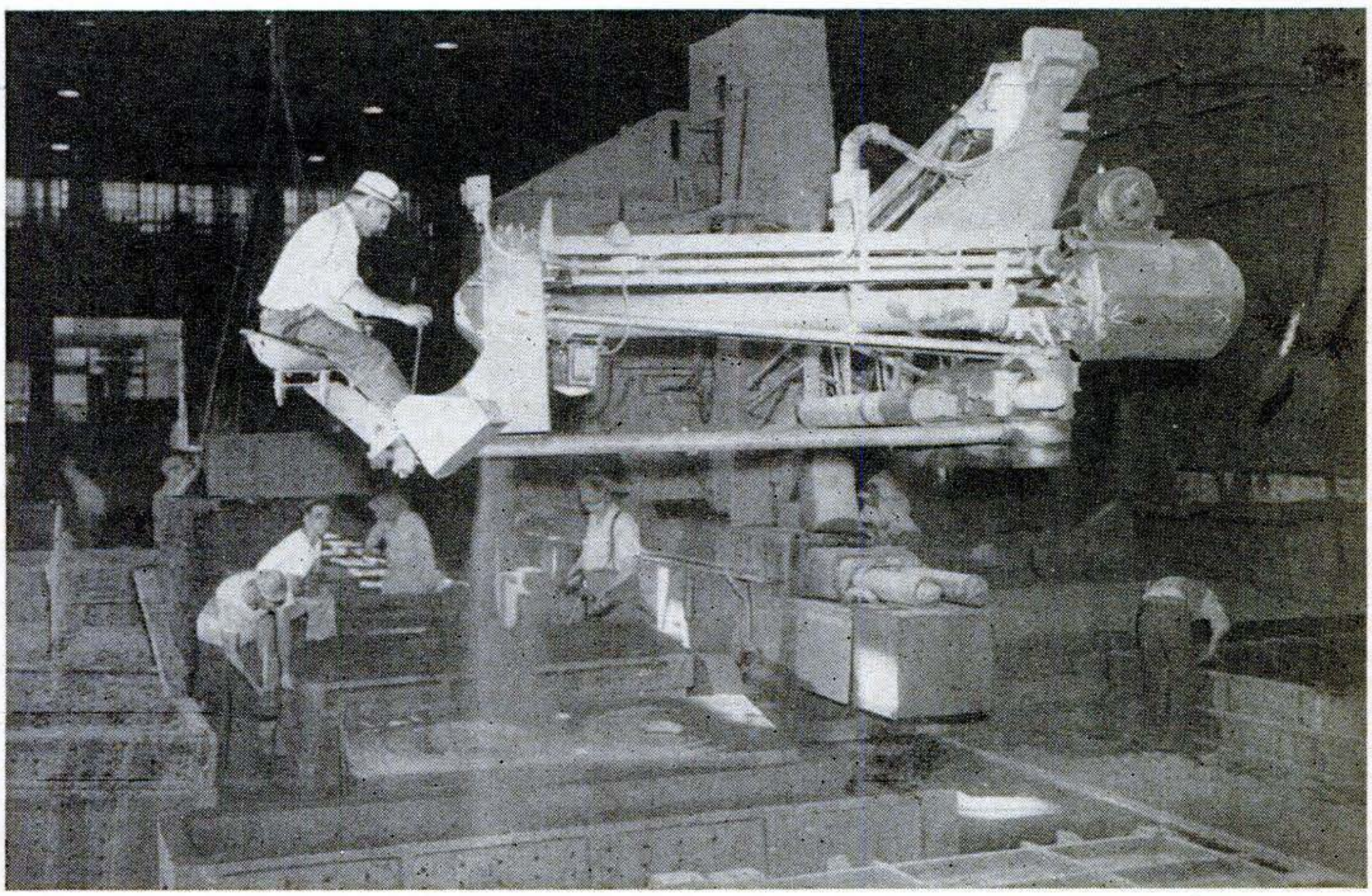
Up in the cockpit, your flight crew likewise is having no visibility problems. Their operating deck is also air-conditioned and pressurized, and special electricity-conducting glass keeps the cockpit windows clear of ice and fog. Should you run into heavy icing conditions, your Stratocruiser's propellers and the leading edges of its wings are heated internally to prevent ice from forming or building up.

Now, after about 10 hours in the air, the pilots are beginning their letdown for a landing at your destination. The Stratocruiser is about 17 tons lighter than it was when you took off: it took that much gasoline to get you where you are.

As the big plane soars over the trees near the end of the runway, you are some 50 feet above the ground. About 1,300 feet farther the wheels touch the ground, and in another 1,800 feet the plane rolls to a stop. This amazingly short landing roll results from the Stratocruiser's use of reversible-pitch propellers whose reverse thrust can be used to aid the brakes. In this particular landing, the pilot had reversed the blades on only two of the plane's propellers. If he had reversed all four, he could have braked his ship to a stop within 1,230 feet after its wheels touched the runway.

By the time you leave your Stratocruiser, maintenance crews will be working over her. Forty-four points of easy access to vital parts have been built into the Stratocruiser to simplify maintenance. By lifting up the hinged leading edge of a wing, a mechanic can get at oil lines, heater and air-conditioning ducts, electric wiring, and other equipment. By lowering the wing flaps he can work, unobstructed, on fuel and oil lines, hydraulic lines, fuel valves, and electric cables. Broad removable manholes under the wings make it easy to get at fuel pumps and fuel cells.

When the Stratocruisers take to the air commercially early next year they will hop from coast to coast in eight hours, make the trip from New York to London in 11½ hours, fly from Seattle to Tokyo in 15 hours, or go three-quarters of the way around the world from Shanghai to London in 38 hours. Their passengers will make those long, fast flights in amazing comfort. For the Stratocruiser is truly the first of the long-talked-about postwar luxury air liners. END



Sand Slinger Fills Molds

THIS mechanical ram speeds the packing of sand molds for steel castings. Cups on the rim of a wheel whirling at 1,800 r.p.m. scoop a ton of sand a minute from a conveyer and hurl it down into the molds. This spray packs them harder than can be done by hand or pneumatic ram. The machine is an improved model used by U. S. Steel.

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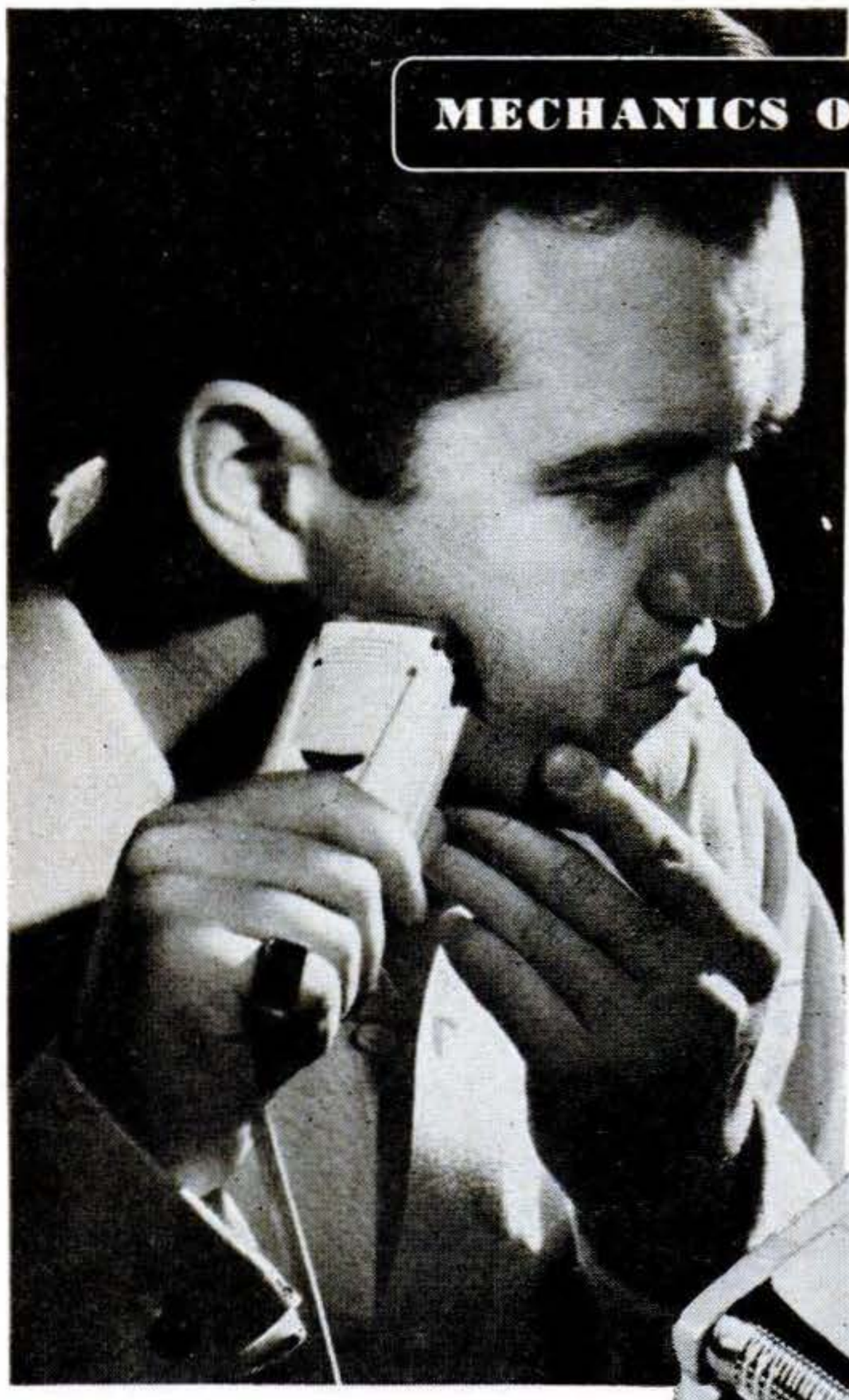
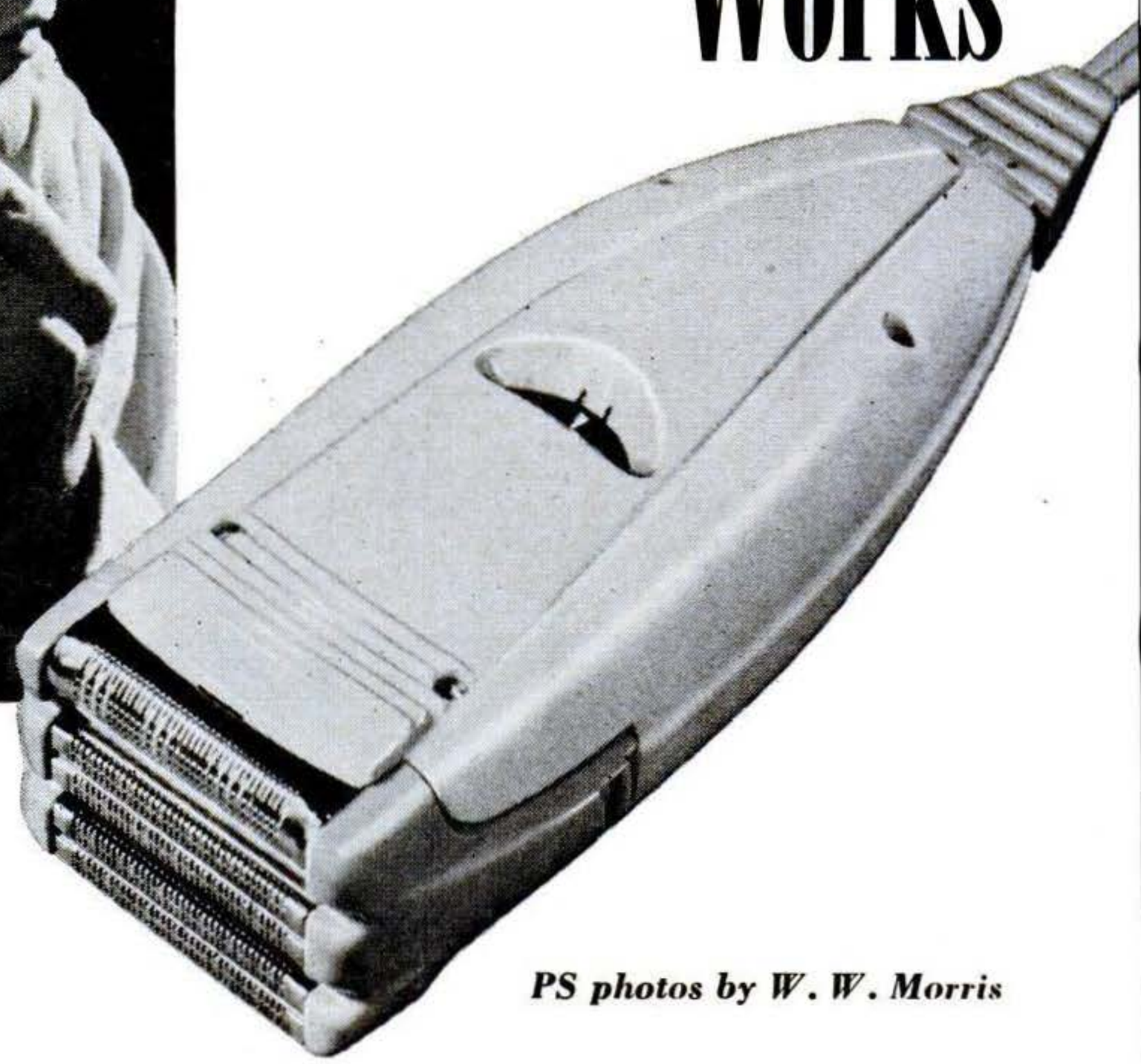
MECHANICS OF LIVING

How an Electric Shaver Works





Razor works best when held at a right angle to skin, as demonstrated above. Shaver, a Remington Blue Streak Five Ⓣ (right), weighs 12 ounces with cord. Head is 1 9/32 in. long, 1¼ in. wide. Entire shaver is 4½ in. long, 2 1/16 in. wide, 1 5/16 in. thick.

PS photos by W. W. Morris

THE humming electric shaver, second only to automobiles as a cause for argument among men, is nothing much more than a refined barber-shop hair clipper: a series of fixed slots to plow up the hair, a series of saw-edged blades to snip it off.

The size and shape of these two basic elements and how they work together differ widely in the scores of shavers that have been on the market at one time or another. The slotted head can be round or flat. The cutting blades can have a semirolling or transverse action. They may cut going both ways or only in one direction. The shaver may have one cutter or as many as five. It may have a brush or impulse motor.

In some early electric shavers the cutters were attached to flexible steel shafts vibrated by buzzerlike arrangements of electromagnets. Most current models have a rotary motor with an eccentric collar on its shaft to move a center-pivoted lever that wiggles the cutter.

The shaver pictured on these pages is claimed to lead the field in sales by its maker, Remington-Rand, Inc.

Remington insists that the man who doesn't like electric shavers just doesn't know how to use them. Here's its recipe: (1) dry face thoroughly; (2) hold shaver at right angle to skin; (3) move it *back and forth* across the beard in light, quick strokes of about two inches; (4) in spots where hair swirls in all directions, use a circular motion.

Doing it right, Remington says, a beginner can shave in five minutes, and practice can cut that time almost in half.

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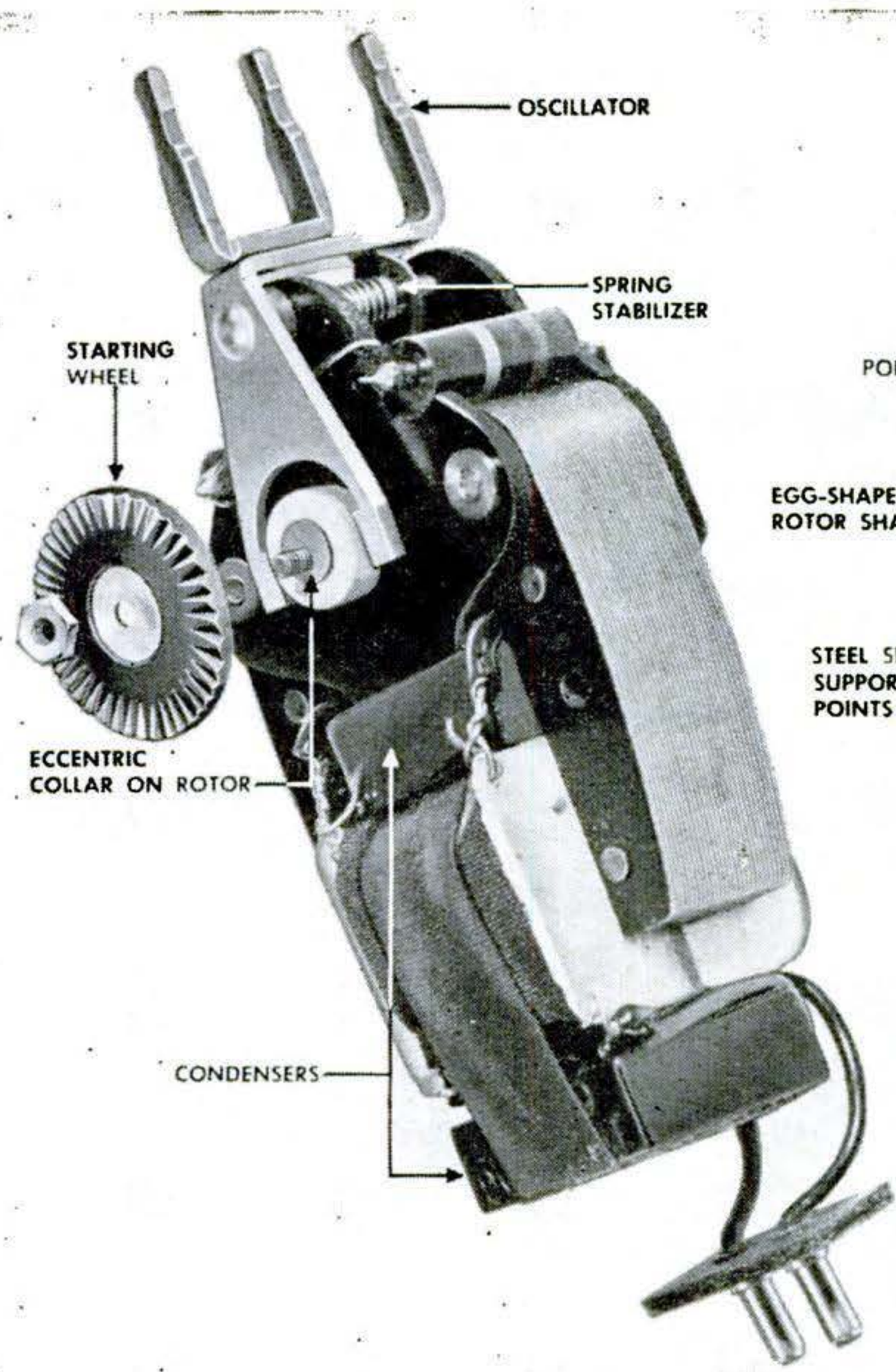
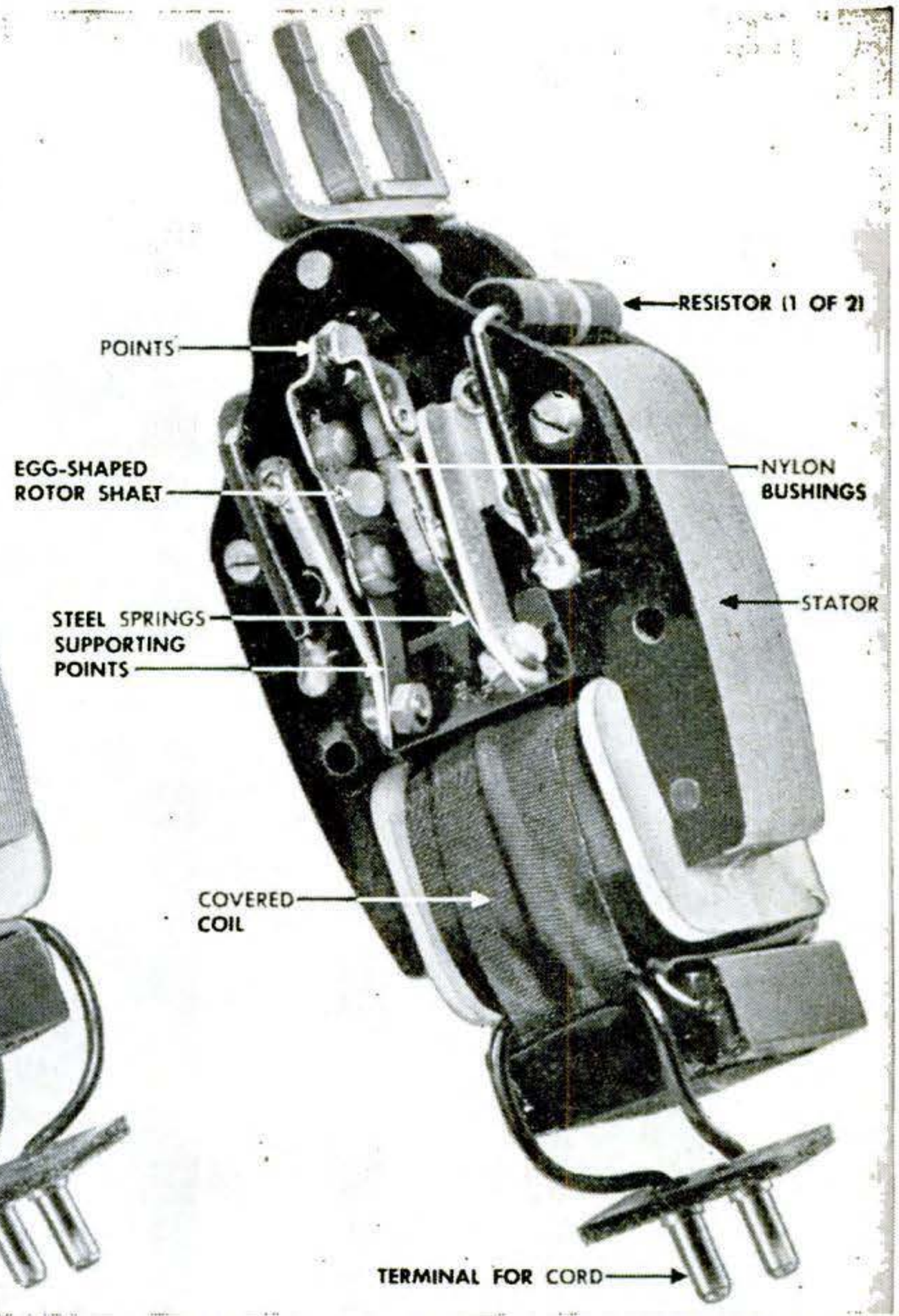
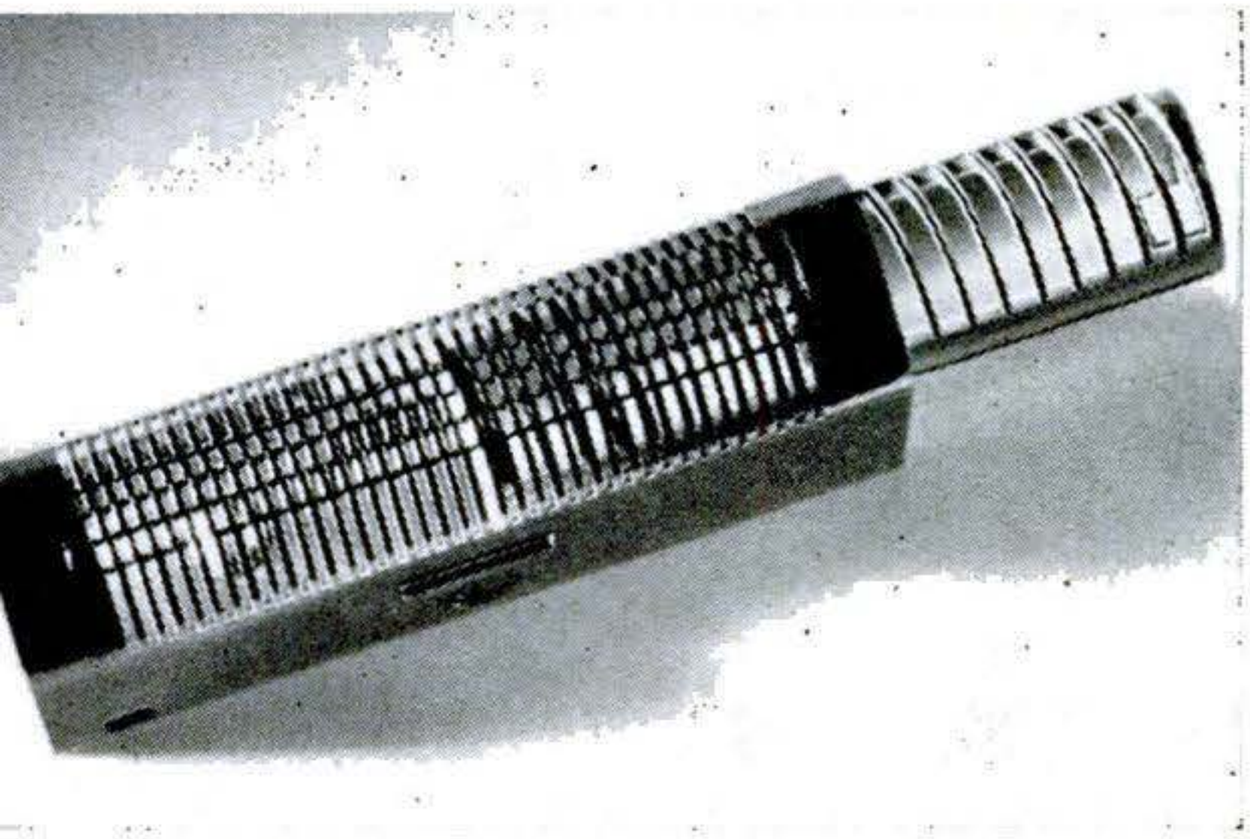
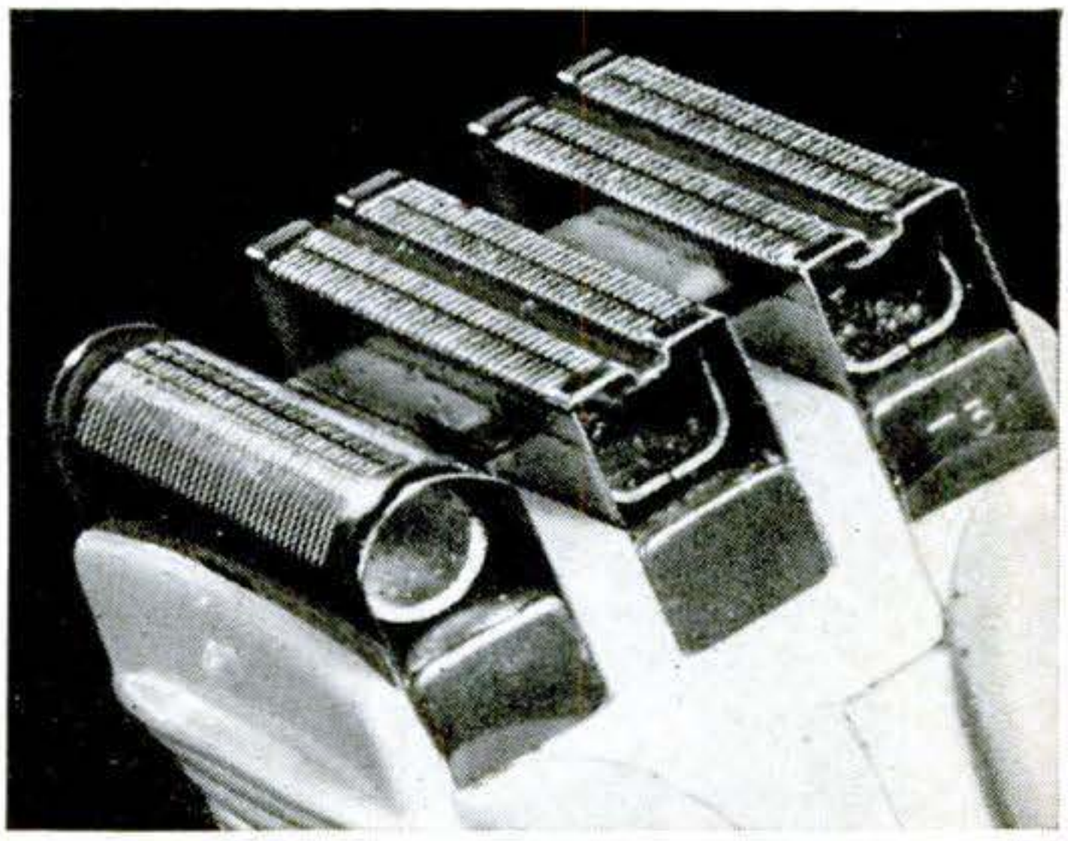




Tiny motor, shown from both sides in photos above and at right, makes 8,500 revolutions a minute. Rim of starting wheel sticks through a slot in shaver's case (as shown on opposite page) so it can be twirled with thumb to get motor off dead center. Under it is eccentric collar on rotor shaft to push oscillator fork once in each direction with each turn of motor. Three oscillator prongs, in turn, vibrate cutters. Egg-shaped collar on other end of shaft pushes contact points apart once with each turn to make-and-break circuit and keep the motor going.



Cutter has 185 slots in 37 rows for hair to go through, 19 double-edged knives that move across them 17,000 times a minute. Here the knives have been slid out far beyond their normal sweep to show how they're shaped to fit closely against the slotted outer shell.



Multiple shaver has one rounded cutter (like the one shown close up in photo at left), for close shaving as skin folds around it, and two pairs of flat cutters for long hairs. Their outer shells, **about .0025** in. thick, are partly supported by the heavier knives just under them.

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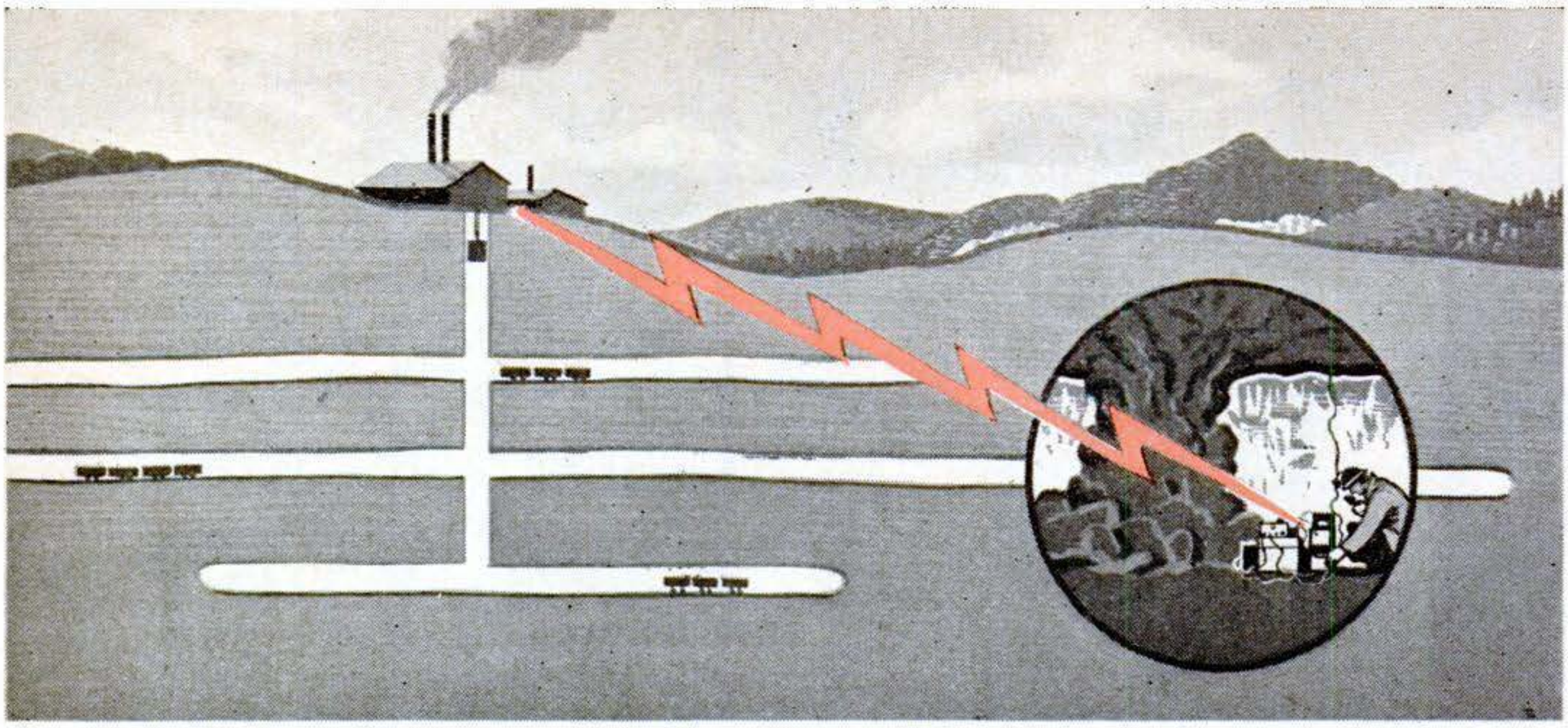


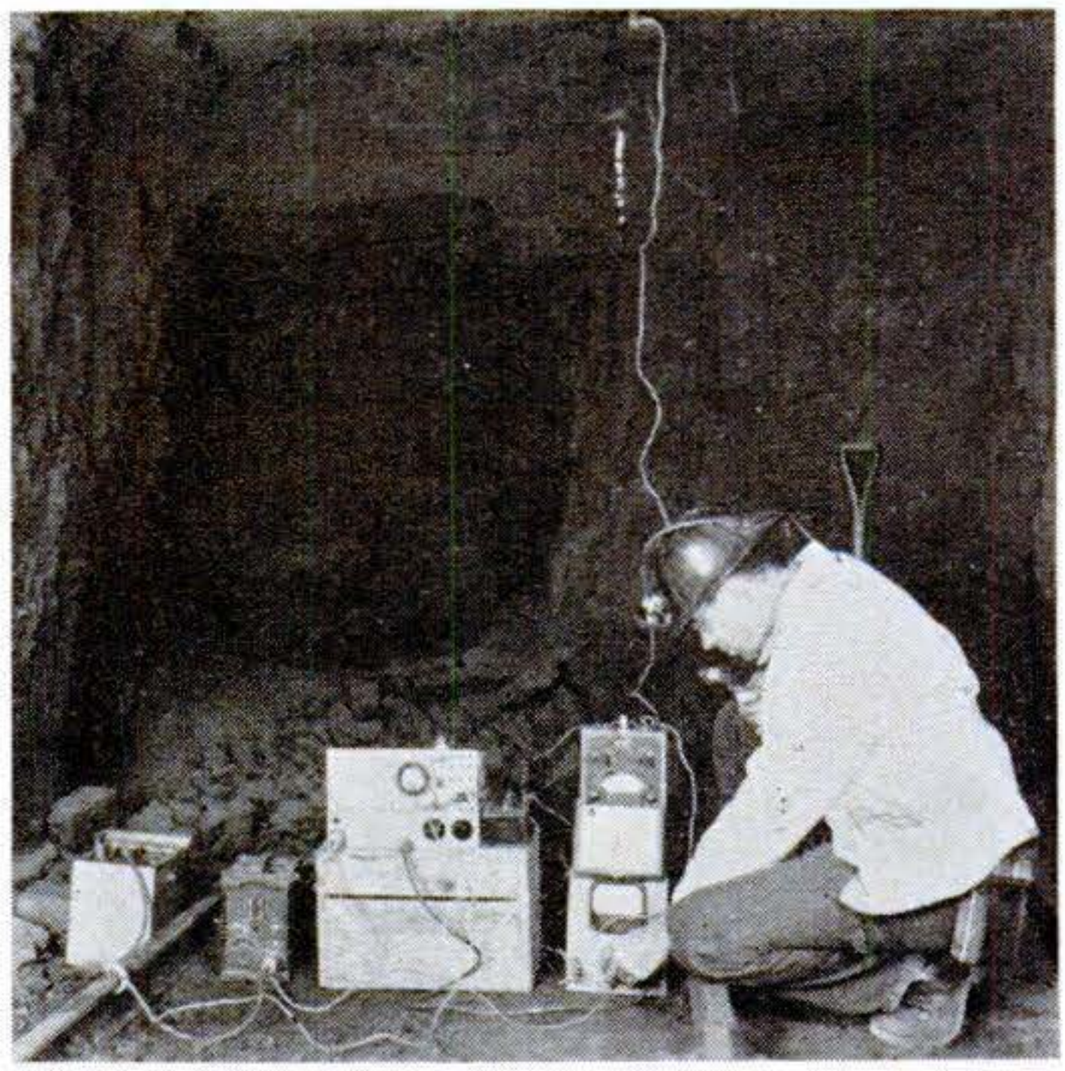
Trapped behind cave-in, miner can quickly radio exact location to surface station, report underground conditions, and help direct rescue work. Communication between points inside the mine and between hoisting cages and operator at top of entrance shaft is also possible.

Mine Radios To Send SOS From Depths

RADIO has come to the rescue of miners who face death when trapped by explosion or cave-in far underground. With a new portable battery set they can radio for help within seconds after disaster strikes.

Developed by the U. S. Bureau of Mines, the new two-way communications system uses low-frequency radio waves to penetrate hundreds of feet underground. Besides being transmitted directly through the earth, signals can be sent over power lines or inductively over wires, pipes or rails.

Surface radio both sends and receives, is powered by 110-volt AC. One terminal is connected to rails, the other to metal stake driven into ground. It transmits on two fixed frequencies.



Underground set, also two-way, needs only 6-volt storage battery with vibrator pack for AC conversion. One terminal wire is staked into roof of tunnel; other is connected to rails.

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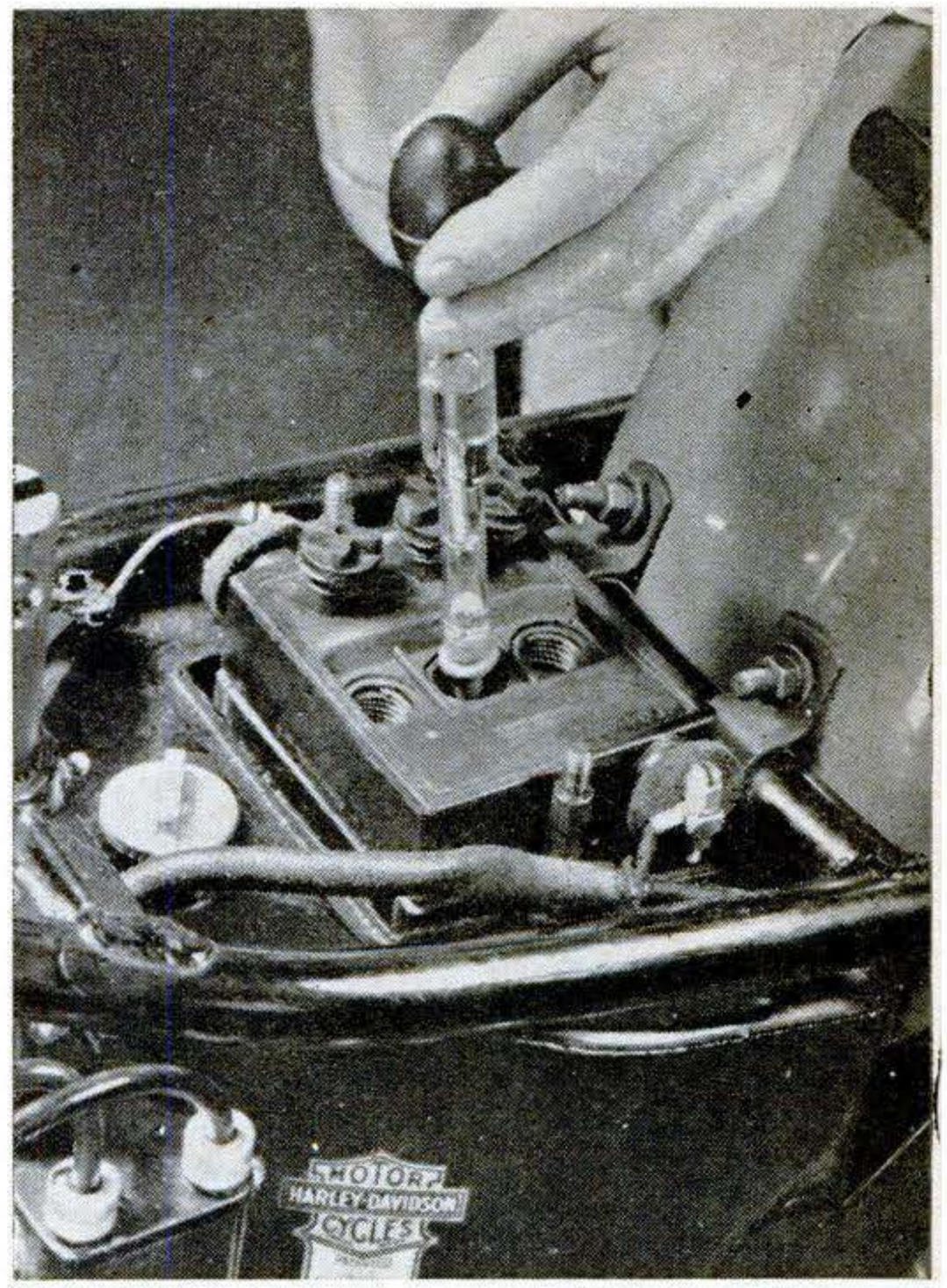
Charging current for a motorcycle battery must not exceed 2 amp. Never connect it directly on an auto-battery charging line. The inset is a cut-away of a Harley-Davidson battery.



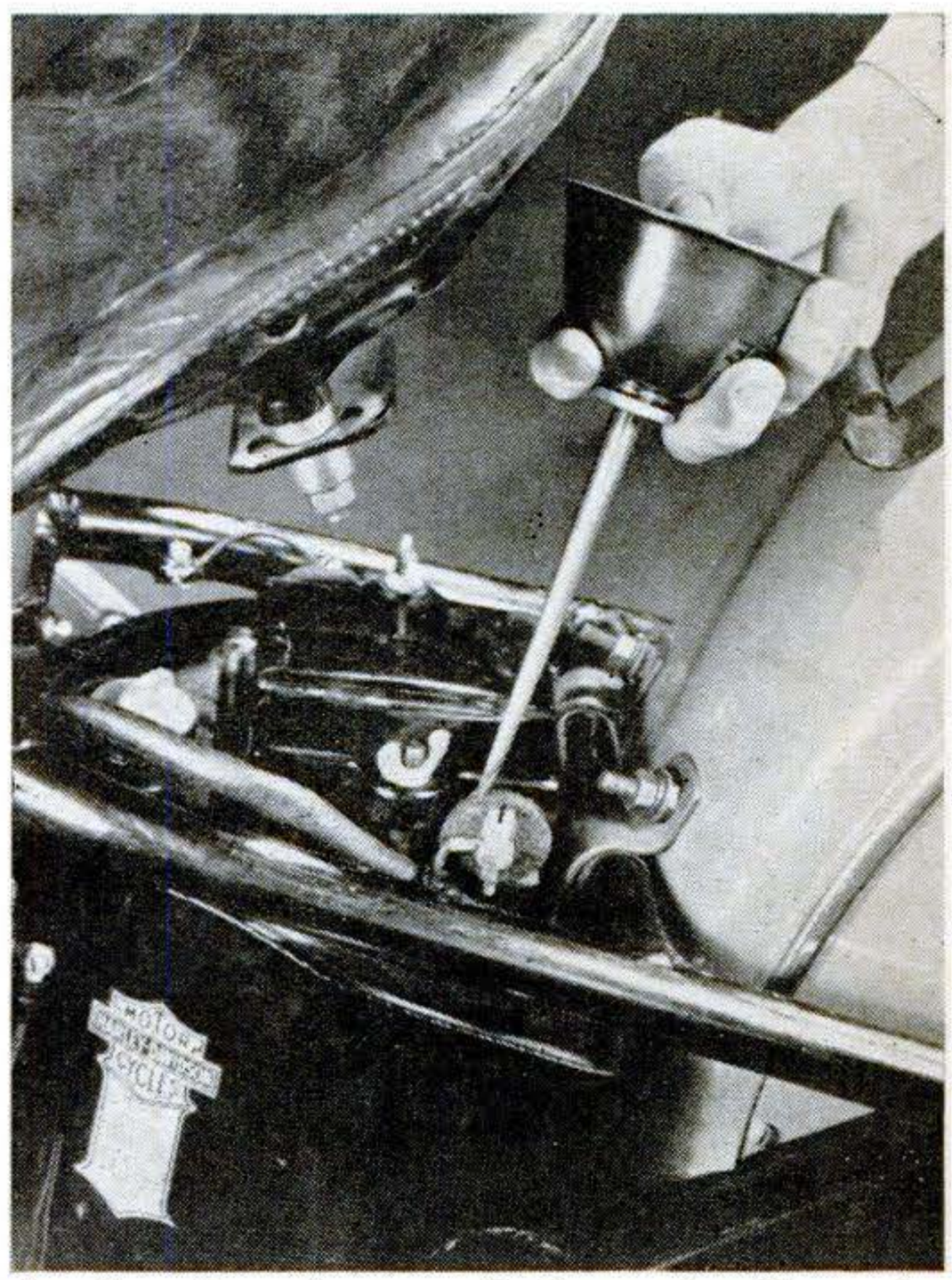
Check the specific gravity each week. At the same time add distilled water if needed. To insure uniform coverage of the plates, make certain the motorcycle is perfectly upright.

More Juice for Your Motorcycle

YOU can't expect to abuse a motorcycle battery and get away with it. In general, you should treat it like an automobile battery. But in some respects it's a special case, requiring extra care.

Make a habit of checking the specific gravity of each cell once a week. If the hydrometer reads 1.150 or less, recharge the battery promptly. With the hydrometer, also add distilled water as necessary to raise the level about 5/16″ above the plates. It's best to do this just before using the machine. Avoid too much water.

Don't hook up a motorcycle battery directly on an auto-battery charging line. The current is excessive. Two amperes is tops for a motorcycle battery. If automobile charging equipment is used, bleed off a lower charging current. This can be done by connecting the battery in parallel with one of the car batteries on charge. Be careful not to charge beyond 1.275 specific gravity.



Apply a drop or two of oil occasionally to the felt washers on the terminals. This forms a protective film on the terminals, preventing corrosion and permitting better lug contact.

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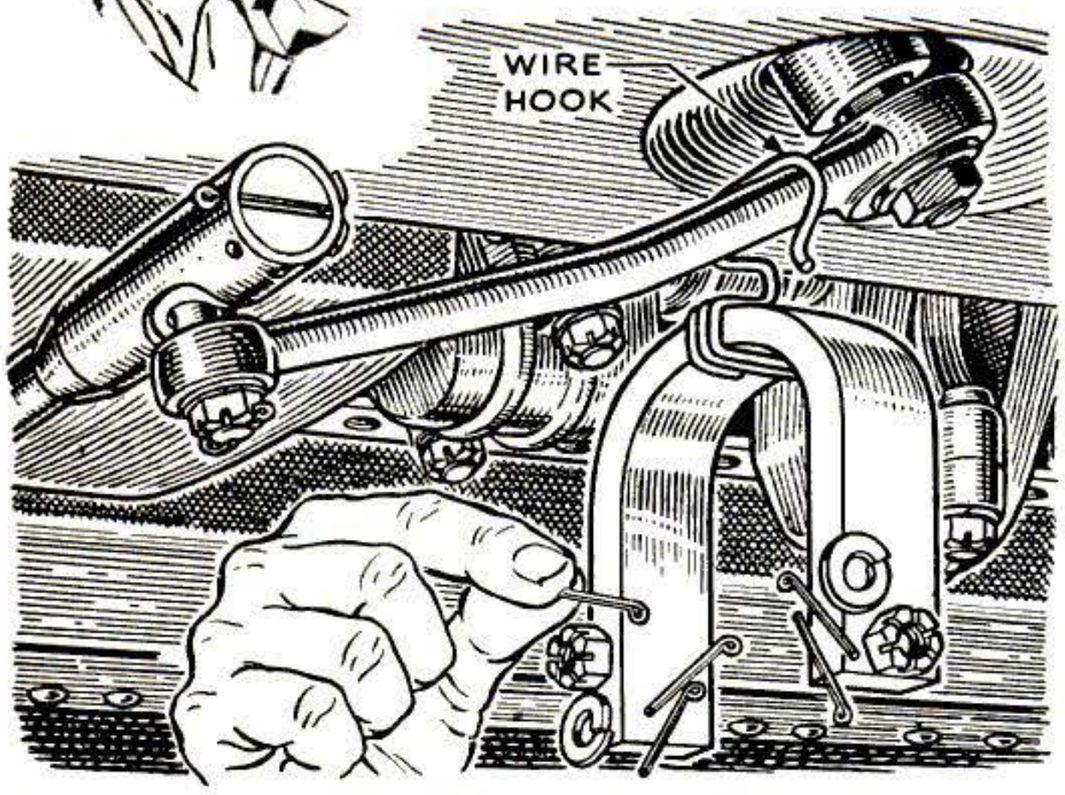
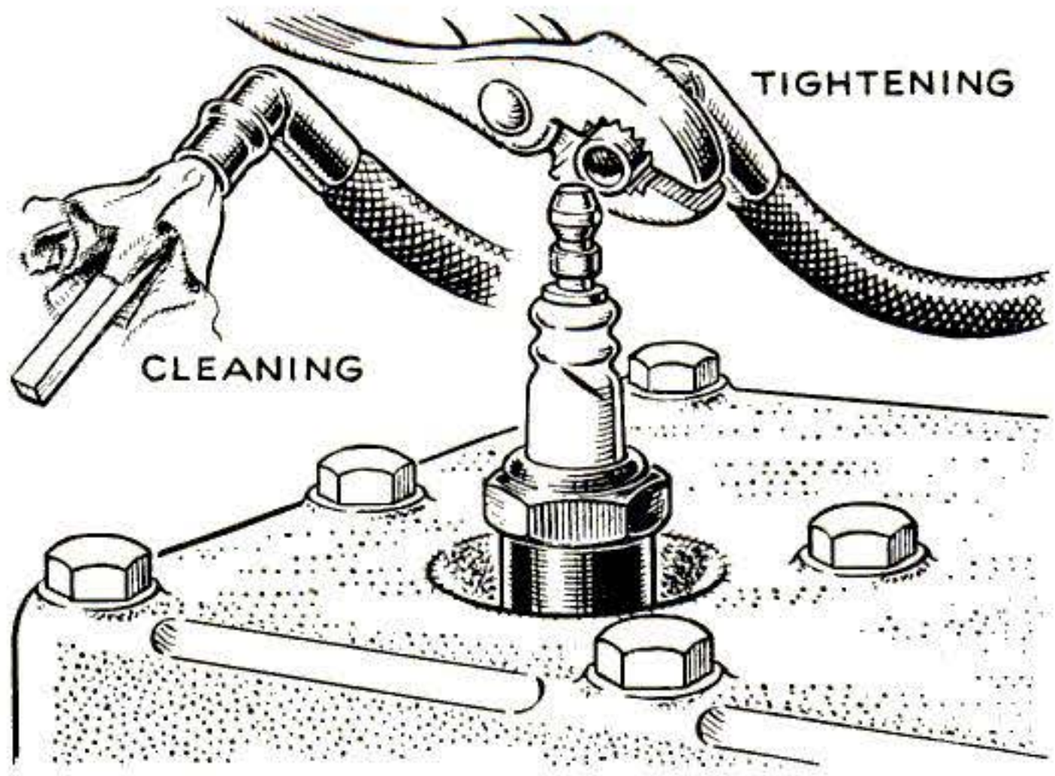
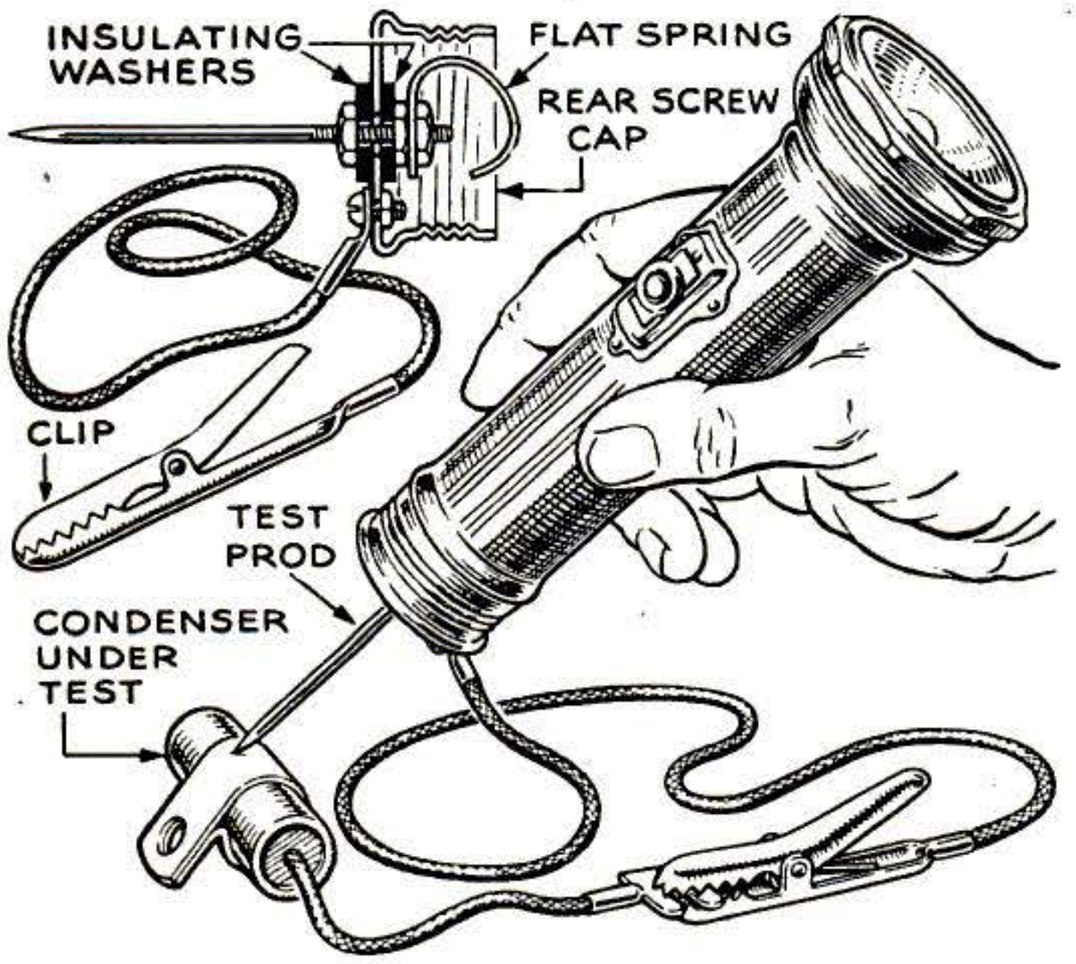
Hints From the Model Garage



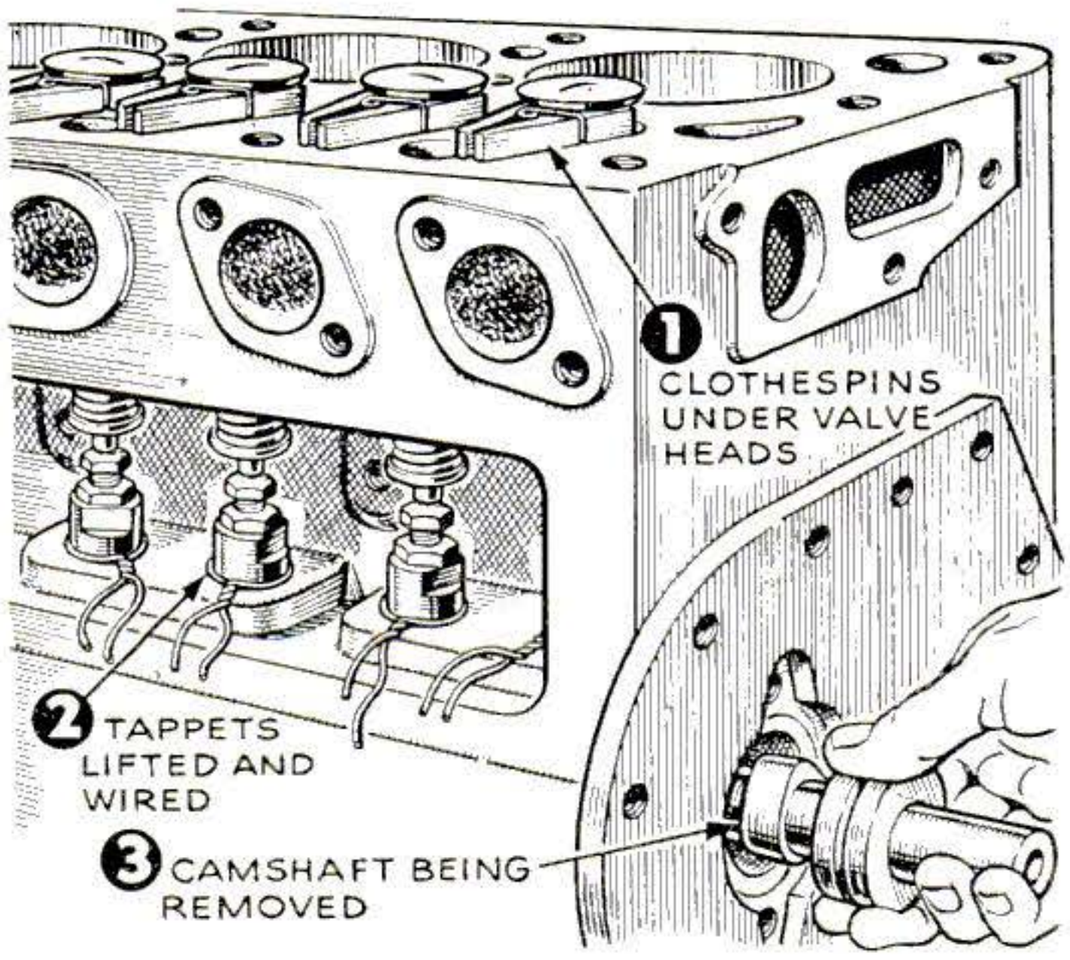
Magnet Holds Small Parts. When you're working under a car, hook a permanent magnet nearby. As you remove nuts, cotter keys, pins, or small parts, just stick them to the magnet. P. R. Wilson, of Brooklin, Ont., says this is a help when you replace the parts. They're right there when you want them, and they don't pick up grit.



Dirty Cap Causes Miss. On high-compression engines, mysterious low-speed missing or bucking may sometimes be traced to poor electrical contacts in the high-tension leads. According to Frank Tobin, of Manhattan, N. Y., cleaning out and tightening the plug caps will often cure skips seemingly caused by defective plugs.



Flashlight Tests Circuits. A flashlight with a metal case makes a good continuity tester. Rufus P. Turner, of New Bedford, Mass., rigged this one. The test prod is a 3″ brass rod threaded for 6-32 nuts and insulated from the cap by fiber washers. The other lead runs directly to the cap. In use, the bulb lights to indicate grounds and shorts. No light shows on an open circuit or an unshorted condenser.



Clothespins Wedge Valves. Here's a time-saver in removing the camshaft of an L-head engine: Instead of removing the valves, springs, and tappets, just raise each valve spring with a valve-spring lifter and wedge a clothespin or piece of wood under the valve head. Then lift and wire each tappet up out of the way. The thrustplate then can be removed and the shaft pulled out. Kaiser-Frazer Corp. suggests this.

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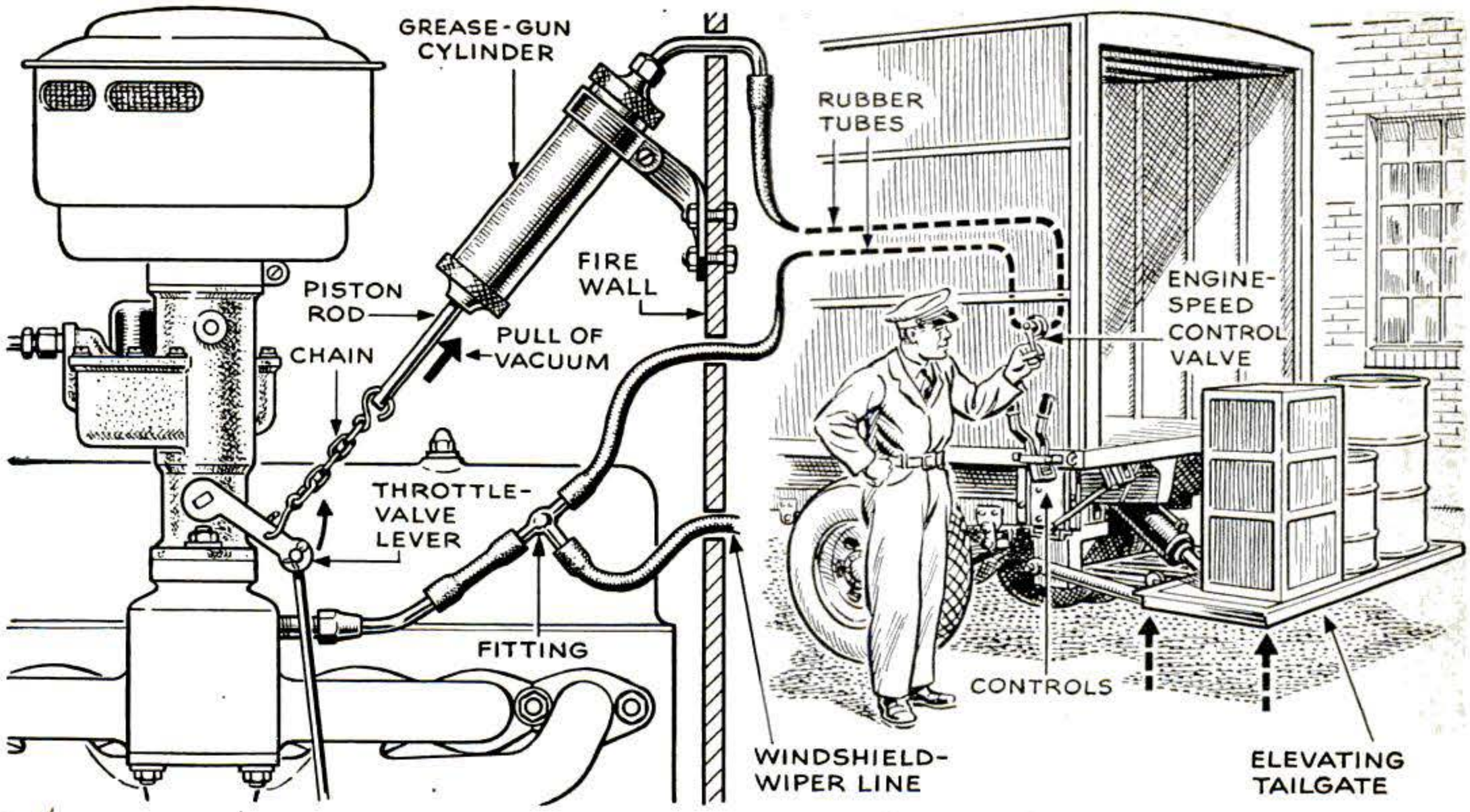
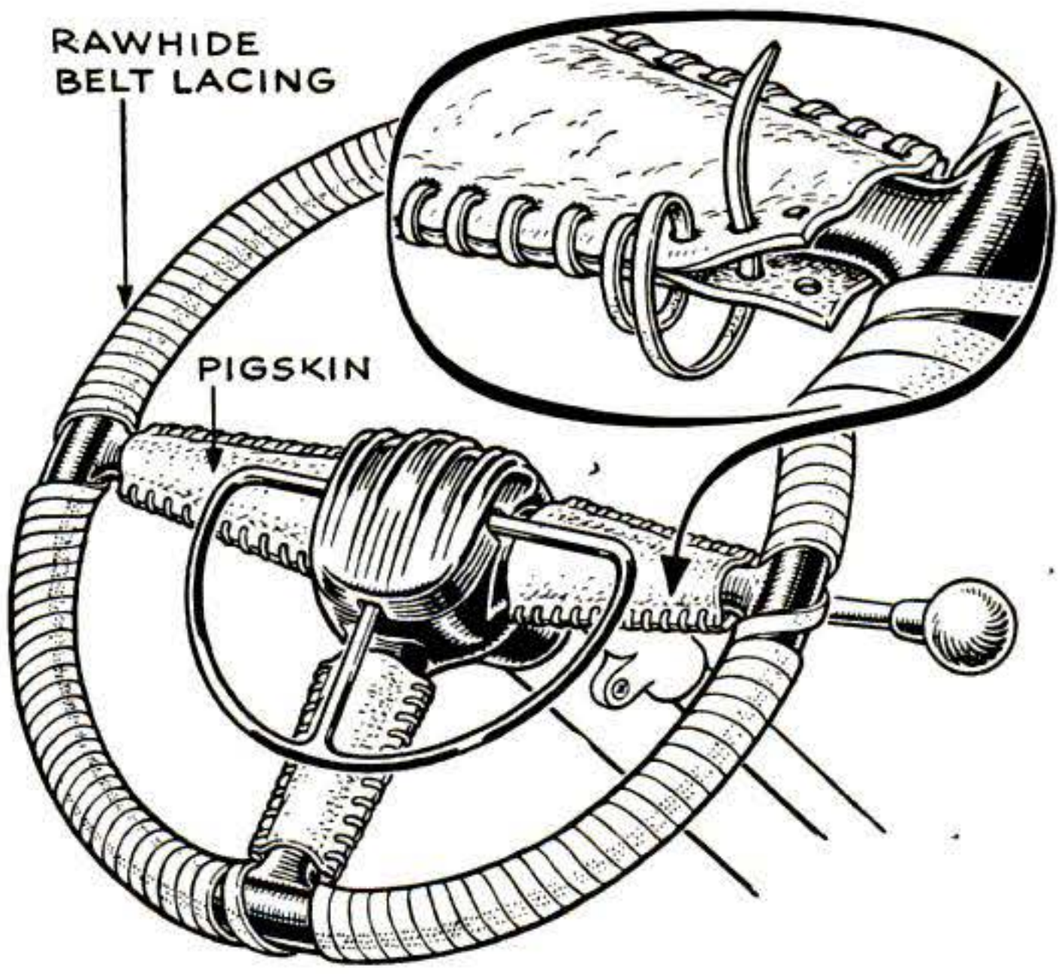
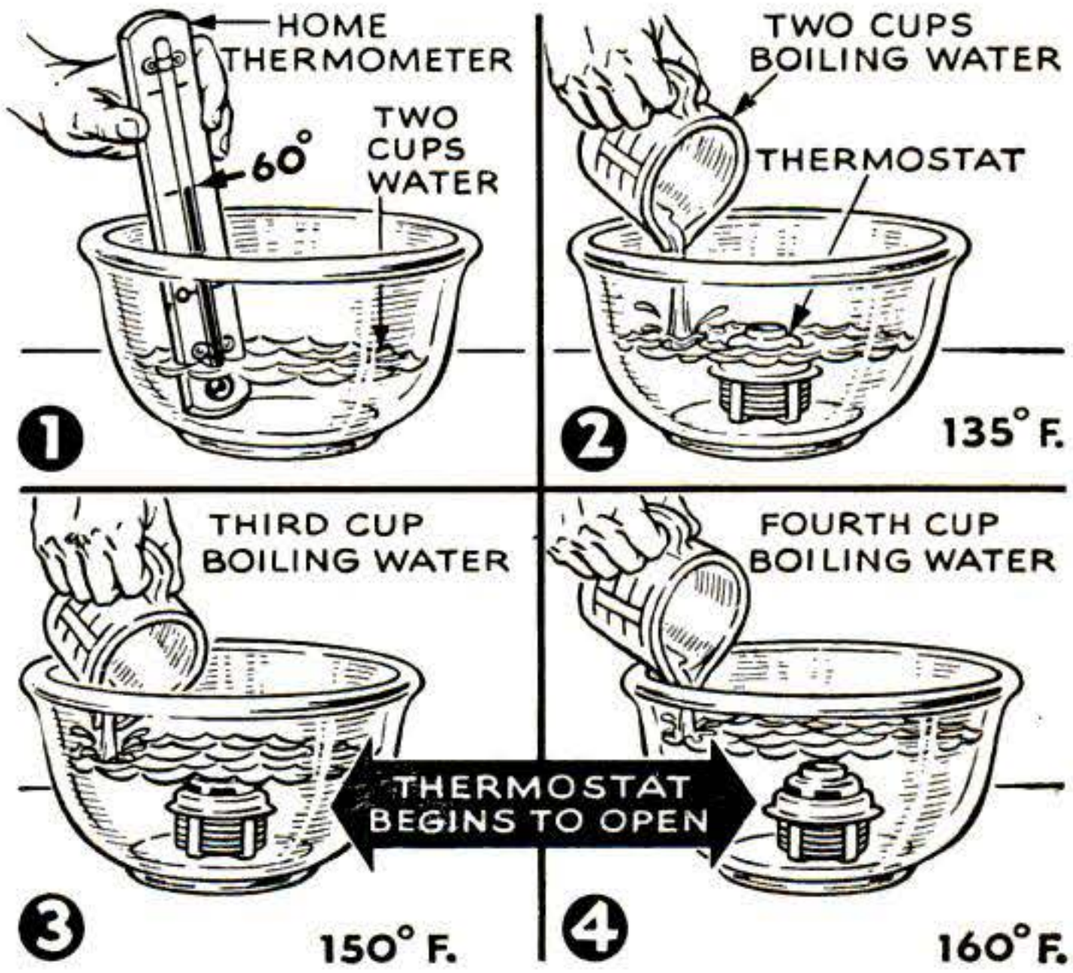


Vacuum Runs Remote Throttle. Powered by a take-off from the engine, an elevating tailgate takes a lot of labor out of truck loading. Mike Walt, of La Porte, Ind., says he had trouble with flexible-cable rigs varying engine speed from the back of the truck, so he built this vacuum-operated remote control. The cylinder is an 8″ grease gun and the lines are windshield-wiper hose. A two-way valve opens the throttle, or in second position bleeds air into the cylinder; letting the throttle-closing spring take over.



Glove for Steering Wheel. You can lend your car a custom-built touch by wrapping the rim of the steering wheel with rawhide thongs and lacing pigskin covers on the spokes. Leather not only has a good feel to begin with, but its texture generally improves with use. Cut the spoke covers as wide as the combined width and thickness of a spoke, and use a darker lacing on the edges.



Checking Thermostats. If you don't have a high-temperature thermometer, you can test auto thermostats with an ordinary one, using a method suggested by Roy Howell, St. Albans, N. Y. Put 2 cups of water at 60 deg. in a bowl with the thermostat, and quickly add 3 cups of boiling water for about 150 deg., 4 cups for 160 deg., 5 for 168 deg., 6 for 174 deg., or 7 for 178 deg. Car manual gives opening point.

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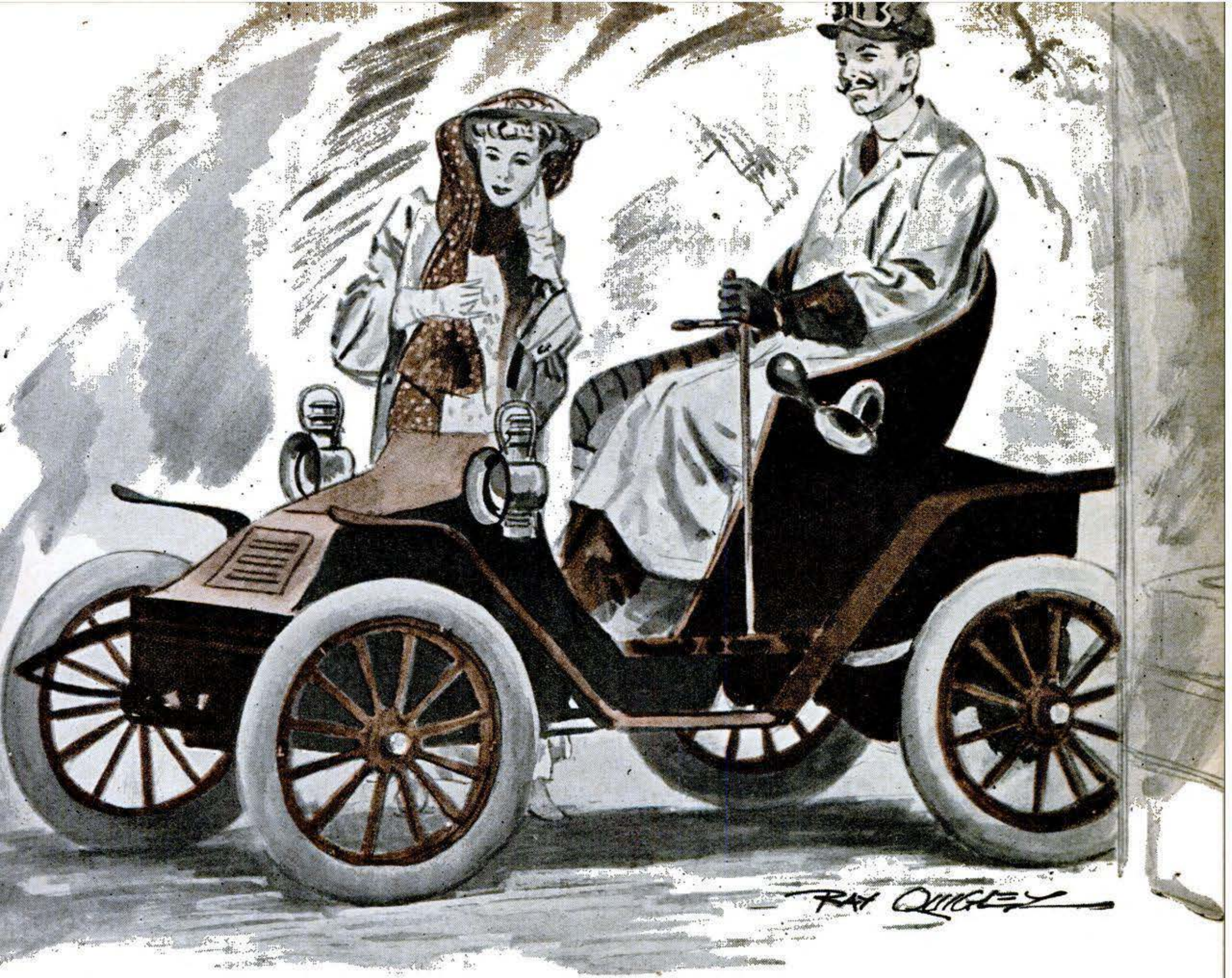
Gus Plugs for Cupid

The curtain of time seemed to be a little frayed the day Gus got mixed up in the romance of old cars and young people.

By Martin Bunn

A CHANCE remark of Joe Clark's had set Gus Wilson to thinking about old times in what he still calls "the auto game." Alone in the shop at four o'clock that day, he was still at it—his chair tilted comfortably, his feet on a parts box, and his gone-out pipe in his mouth. By that time memory had taken him back to the Orient—that long forgotten motor buckboard with a rear-mounted power plant. How many people

The antique Autocar sparkled under a shiny red coat of paint. Its plentiful brass trim gleamed in the wisps of afternoon sunlight.



are there still around, he wondered, who ever drove an Orient? How many . . .

His eyes closed, his chin dropped, and his pipe slipped from between his teeth to spill cold ashes down the front of his shirt.

The creak of the shop door made him jerk up his head. As his eyes snapped open his heels thudded down on the cement floor with a jar that should have wakened him. But he knew that he was dreaming, because there in his up-to-the-minute shop stood an antique Autocar looking sparkling and new under a shiny red coat of paint. Its plentiful brass trim gleamed in the wisps of afternoon sunlight that followed the car through the door. At the tiller—for it had no steering wheel—was a tall, thin man whose face was half masked by old-fashioned goggles and a big, black, handlebar mustache.

A short distance behind the prehistoric vehicle and its driver came another—but prettier—vision of the same forgotten era—a young lady in a fawn-colored riding coat with puffed-out sleeves and long skirts that flared from a slender waist.

Gus stared at the two and they stared back at him. Then the girl giggled and the man grinned. "You Gus Wilson?" he asked.

Gus nodded. He couldn't get his tongue working.

"My name's Oldfield. . . . Not Barney—J. Ransome Oldfield. I'm the fellow who owns the world's best collection of early-model automobiles."

Gus laughed. So he *was* awake! He had heard about Oldfield—a rich man who recently bought a big country place outside town. Oldfield was gaining more than a local reputation as a man who would spare no effort in tracking down early cars.

"I should have known you," Gus smiled cordially. "This one of your prizes?"

"Sure is," Oldfield said proudly. "Over forty years old and absolutely perfect. I'm driving it down to the antique car show in the Armory. All entries must arrive under their own power. Costumes count, too. That's why Mary here—she's my daughter—and I are wearing these rigs. They're as authentic as the car. Even my mustache—I

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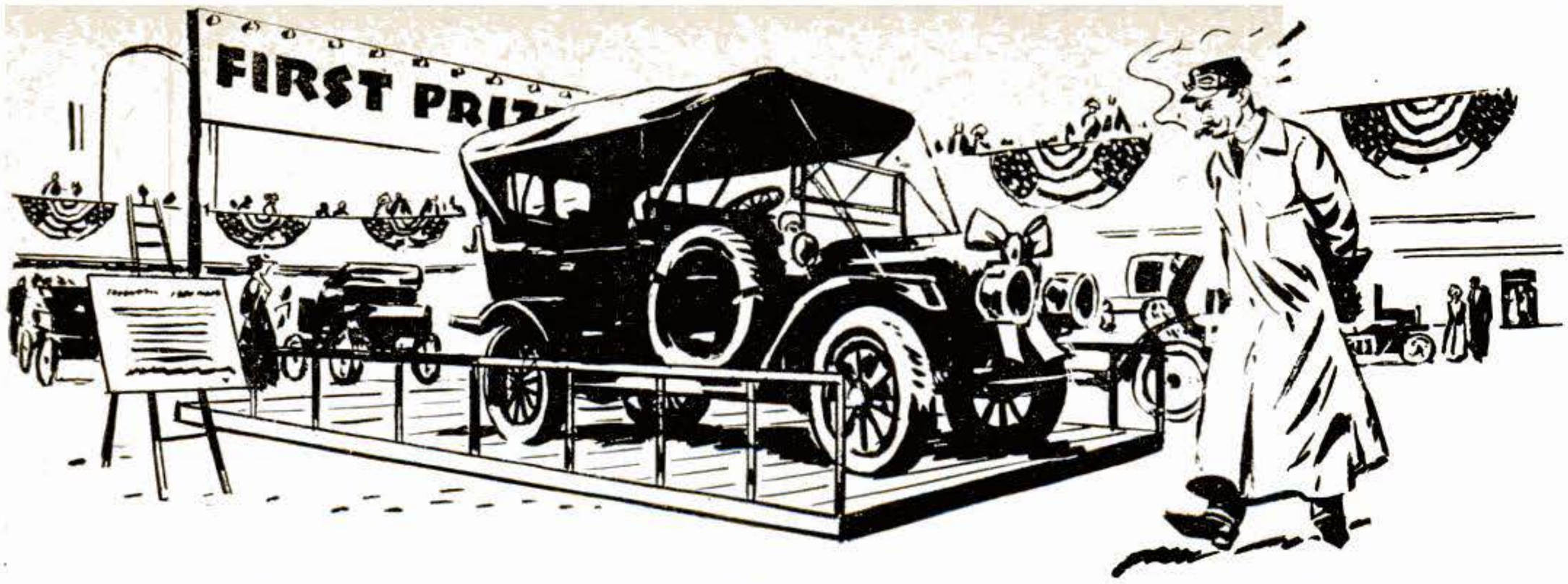

grew it specially for this show. Like it?"

Mary giggled again. "Supersonic!" she said. "Poor Tim Sheridan won't have a chance once the judges spot it!"

Oldfield glared at her. "That young squirt and his patched-up Stanley Steamer won't have a chance!"

Mary's blue eyes sparkled cold fire. "Tim's no squirt and you know it!" she snapped. "You're scared stiff he'll beat you out of that ugly old mug you're so set on winning."

Gus didn't say anything. Lanky Tim Sheridan is a favorite of his—he almost grew up in the Model Garage shop, and Gus was the first to realize that he had the makings of a mechanical genius. Tim's a top-drawer engineer now, but he still sees Gus often.

Oldfield left off scowling at his daughter and turned back to Gus. "We're having a little trouble," he said. "Brakes don't hold the way they should. They tell me you're a pretty good mechanic so I stopped by to ask you to take a look at them."

"Glad to," Gus assented. He started toward the old Autocar and looked it over almost with reverence.

The owner grinned delightedly. "She's a honey—every part original or made from the original shop drawings. Absolutely authentic. Wait a moment till I start her up."

It took more than a moment, but after Oldfield had twisted the crank a dozen times the motor took hold.

Gus nodded his appreciation. "Whatever's wrong with the old gal, it certainly isn't her engine."

Oldfield glared. "There's nothing—absolutely nothing—wrong with this car! She'll do her 30 miles an hour come hell or high water!"

"But," Gus reminded him, "you told me the brakes don't hold right."

"You got me wrong," the older man grinned. "It's my daughter's car, only a few months off the assembly line, that we're having trouble with."

Mary went out of the shop and soon eased an expensive roadster up the drive and brought it to a cautious stop behind the old Autocar. "These brakes," she complained, "are simply terrible. I've got to have them fixed today." She looked defiantly at her father. "I've got a date with Tim in the city tomorrow morning."

Her father grunted disgustedly. "We'll leave Mary's car with you, Mr. Wilson. Do whatever is necessary and bill me."

Mary stuck out a small and determined chin. "How am I going to get my car back so I can use it first thing in the morning?"

"I'd like to see this old-car show," Gus told her. "Suppose I fix up your brakes and drive it down to the Armory this evening?"

"We'll bring you home," Oldfield boomed. "I hope you have better luck with the brakes than the other fellow who worked on 'em. The real trouble started after he had fixed a small leak and added brake fluid. . . . Look us up in Box A-20."

Gus watched the old Autocar chug stolidly out. Then he got into Mary's car and gingerly tried out the brakes. A few stops told him most of what he wanted to know. He drove it onto the hoist.

Stan Hicks was returning from a tow job as Gus emerged from under the car rubbing a bit of black gummy substance between his thumb and forefinger. "The hose connections look like Swiss cheese," Gus muttered. "Whoever the darned fool was who worked on these brakes, he added some of that war-surplus aircraft hydraulic fluid that garagemen have been warned not to use on cars. It's rotted all the rubber parts of the brake system. We'll have to clean out the line thoroughly and install new brake hose and cylinder cups. Give me a hand, Stan—I promised it for this evening."

IT PROVED to be a long job. By the time Gus had showered and changed, eaten his dinner and driven down to the Armory, the judging had been completed.

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Tim Sheridan's steam car stood in the place of honor. A large blue ribbon dangled from its front. Pacing the floor before it, Oldfield chewed savagely at a battered cigar.

"Where've you been?" he challenged Gus. "Never mind. Got the car? Where is it?"

"Down the street," Gus said mildly, falling into step alongside Oldfield as the other headed for the door. "What's up? I see Tim won the show."

"Pigheaded judges! Gross discrimination! He won the performance test and five minutes later his old teakettle ran out of steam right in front of the judges' stand!"

"Well, he *did* win the performance test," Gus remonstrated gently.

"He had no right to," Oldfield snapped. "My Autocar stood up right through the tests and it could go through them all over again. Besides I got hold of a note he sent to Mary right after the judging. Those two are up to something and I don't like it!"

As the two men threaded their way toward the door, Oldfield stormed on about Tim and Mary and swore that he had sure proofs that an elopement was in the making. "Let's get to the car before she finds it," he urged. "Mary has a duplicate key. Sheridan stole the cup from me, but I'll be danged if I let him steal my daughter!"

They had reached the main door. An attendant saluted Oldfield.

"Good night, sir. Your daughter said not to worry, she'd drive the Autocar back real slow."

"Drive my Autocar? When? Where? How?"

"Half an hour ago. I think you were argu—talking with the judges, sir. Mr. Sheridan who won the cup was with her."

Oldfield swore. "I wasn't sure till now that they meant to elope tonight. Mary's got a cousin who's a judge up in Glenn Hills. That's where they'll be heading. Come on, man! We can still get there in time to stop that marriage!"

Gus, grinning inwardly, managed to waste a full five minutes in looking for the car, but eventually they found it.

"You drive!" gasped Oldfield. "I'm winded—and besides I'm too mad."

They started uptown. The city traffic was sticky, and Gus, who can snake a car through a jam as fast as any taxi driver, managed to make it slow going. But out in the suburbs he had to quit stalling. "Step on it!" Oldfield urged. "We can get there first. That Autocar won't go over thirty. I'll take the tickets and pay any fines you get."

Gus stepped on it, goaded on by the irate father. He was thinking hard as he drove, remembering a place where the road forked.

The Y in the road showed in the headlights a few miles before Glenn Hills. The left fork led to Oldfield's destination, the right to Gus's. Gus swung to the right.

"Stop!" Oldfield yelled. "You're on the wrong road!"

Gus jammed on the brakes and brought the car to a neck-snapping stop. A glance over his shoulder showed him a dark roadside bank, and he backed into it—hard. Then he shot into the Glenn Hills road. But before they had gone a hundred feet, the engine missed, sputtered, and died.

"What's the matter now?"

"Dunno," Gus replied. "I'll have to check."

He got out, raised the hood, and began slowly—very slowly—to examine the engine.

THEY were in the same spot a short time later when headlights flared weakly from the direction of Glenn Hills. A car approached slowly and drew into range of the roadster's bright lights. It was Oldfield's Autocar—with Tim driving and Mary sitting beside him singing "My Merry Oldsmobile."

"What's the meaning of this?" Oldfield roared.

The Autocar stopped. "Why, it's Dad!" Mary said. "We're married, Dad. There's nothing you can do about it, so you might as well make friends with Tim. And, Dad —he knows about an old Ford that's simply out of this world!"

"Humph!" Oldfield grunted, but anger didn't show up very strongly in his frown. "I don't like this sneaking off with my car—I mean my daughter—to get married. But I've never been able to get a really good early Ford. Where is it—Tim?"

Seeing everyone busy, Gus walked quietly around to the rear end of the roadster and began digging sticky red clay out of its exhaust pipe. Just as he was finishing the job Tim came looking for him. He stared at the pipe, and then at Gus. "Dirty work, eh?"

Gus grinned. "Well," he said, "I knew that you and Mary needed a little time—and I don't know anything that'll stop a car quicker and deader than a nice plug of clay in its exhaust pipe. The bank I backed into right on the other side of this fork was made to order for the job." END

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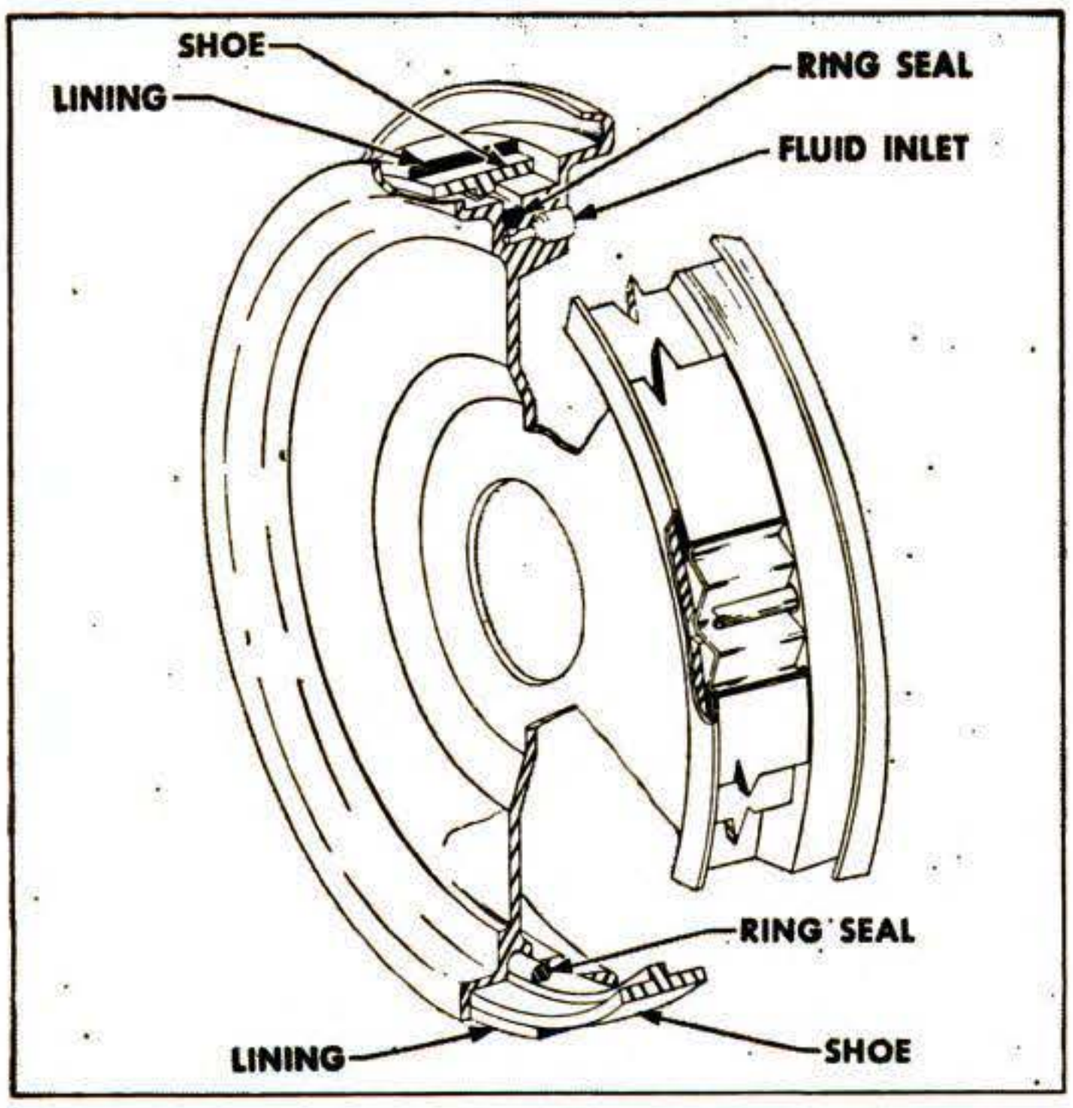
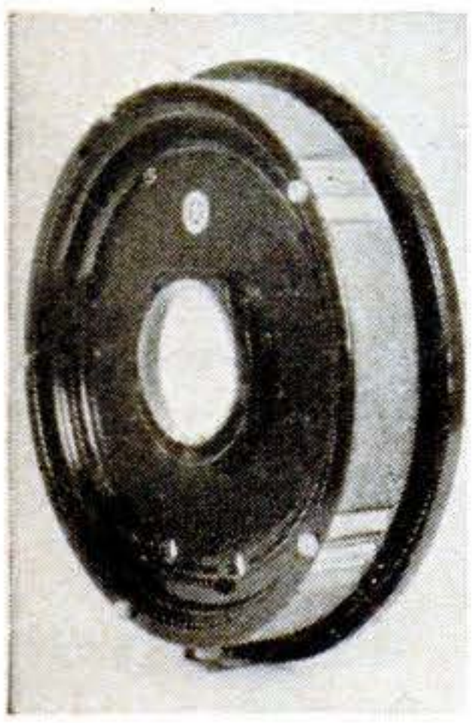
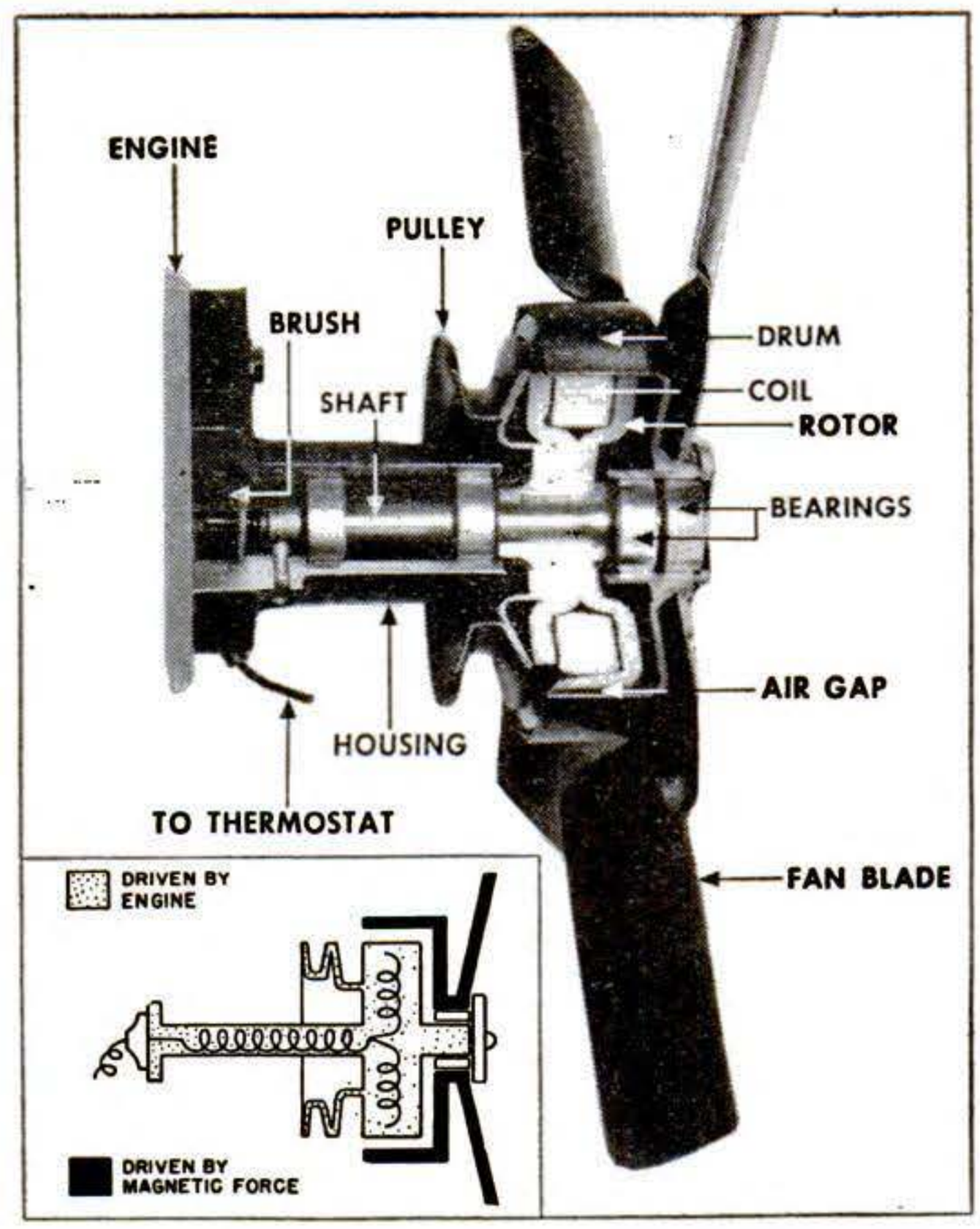


New Brake Has Fewer Parts



ADAPTED from a successful aircraft brake, this new hydraulic automobile brake has fewer parts than the conventional type. A product of the Glenn L. Martin Company, it's now undergoing extensive tests on cars.

A continuous flexible ring seal fits in a groove in the brake shoe support. When the pedal is operated, hydraulic fluid enters the groove under the seal. This forces out the seal and brake shoe, causing the shoe to make virtually a 360-deg. engagement with the lining. It's expected that this will make linings wear much longer. The new brake doesn't require the wheel cylinders, pistons, and linkages found in the ordinary type.



Ford Fan Runs Only as Needed

A CONTROLLED fan offered by the Ford Motor Company runs only while the engine is warm. In cold weather, it seldom starts.

Its heart is the Dynamatic Drive Ⓣ developed by the Eaton Mfg. Co., of Cleveland. This is an electromagnetic unit consisting of two basic parts, a coil and an outer drum on a common shaft. Belt-driven by the engine, the coil revolves constantly.

When the water temperature rises, a thermostat in the radiator hose shoots current to the coil. Magnetized, the coil causes the drum (and attached fan) to revolve in unison. The thermostat assembly varies the voltage with water temperature, speeding up or slowing down the fan as cooling requirements change. The fan is available only as a V-8 accessory for '42 to '48 models.

AIDS TO MODERN LIVING

IN ORDER to give it plenty of elbow room, the Aids to Modern Living department has been moved from its usual place to pages 298 to 301 in the back advertising section. There more space will be available as needed to tell the story of ingenious new household products as they come on the market. We think you will find the department—which is already one of the most popular in PS—bigger and better than ever. And the space it leaves behind will give room for more articles on new projects and techniques you use in your own shop.

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Mechanics and Handicraft

REG. U. S. PAT. OFF.

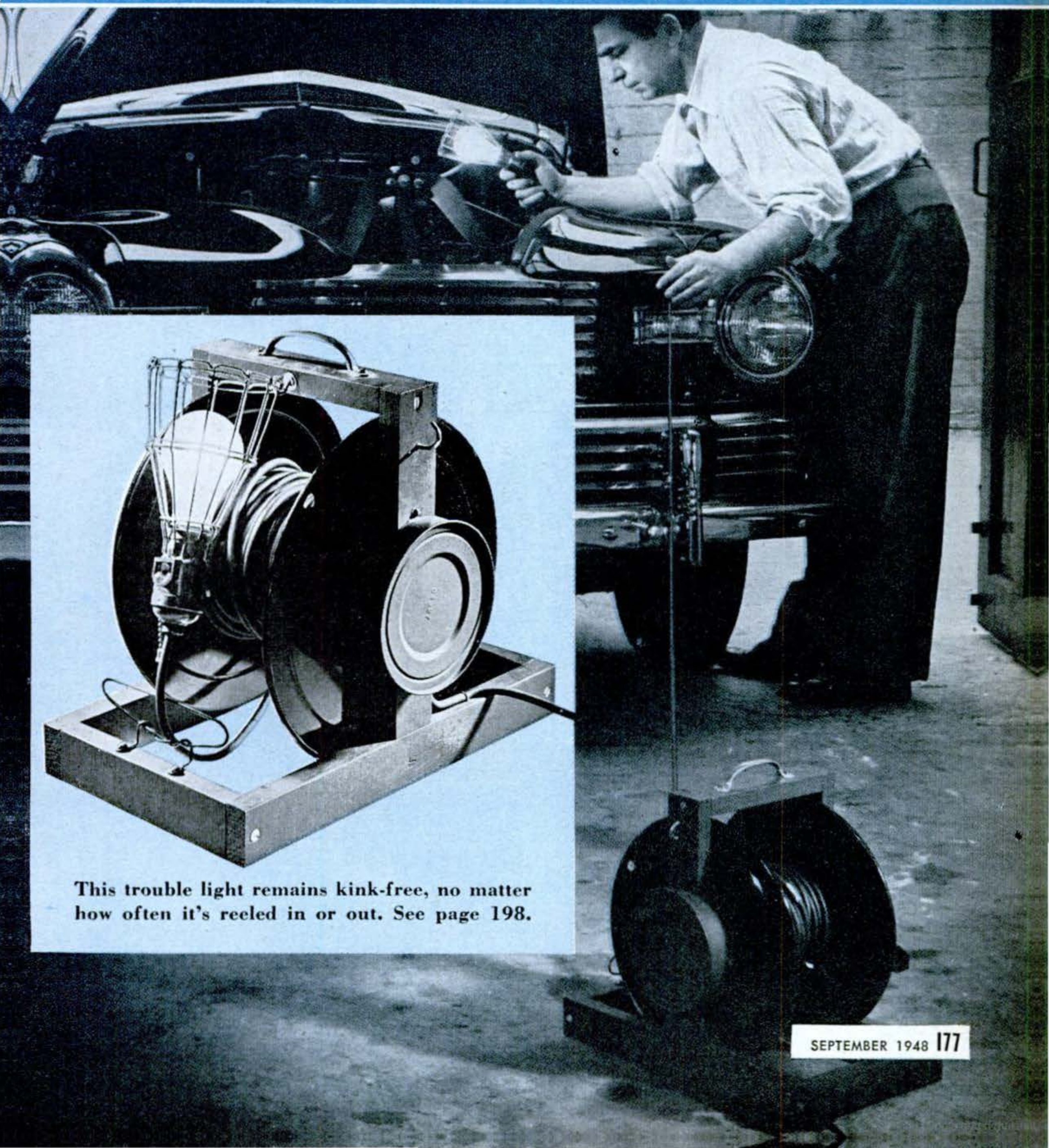
Wind Up Your Trouble Light PAGE 198

Building Radiator Covers PAGE 186

How to Repair Tile Walls PAGE 194

Telescopic Glasses PAGE 213

Ball-Game Portable Radio PAGE 224



This trouble light remains kink-free, no matter how often it's reeled in or out. See page 198.

5065

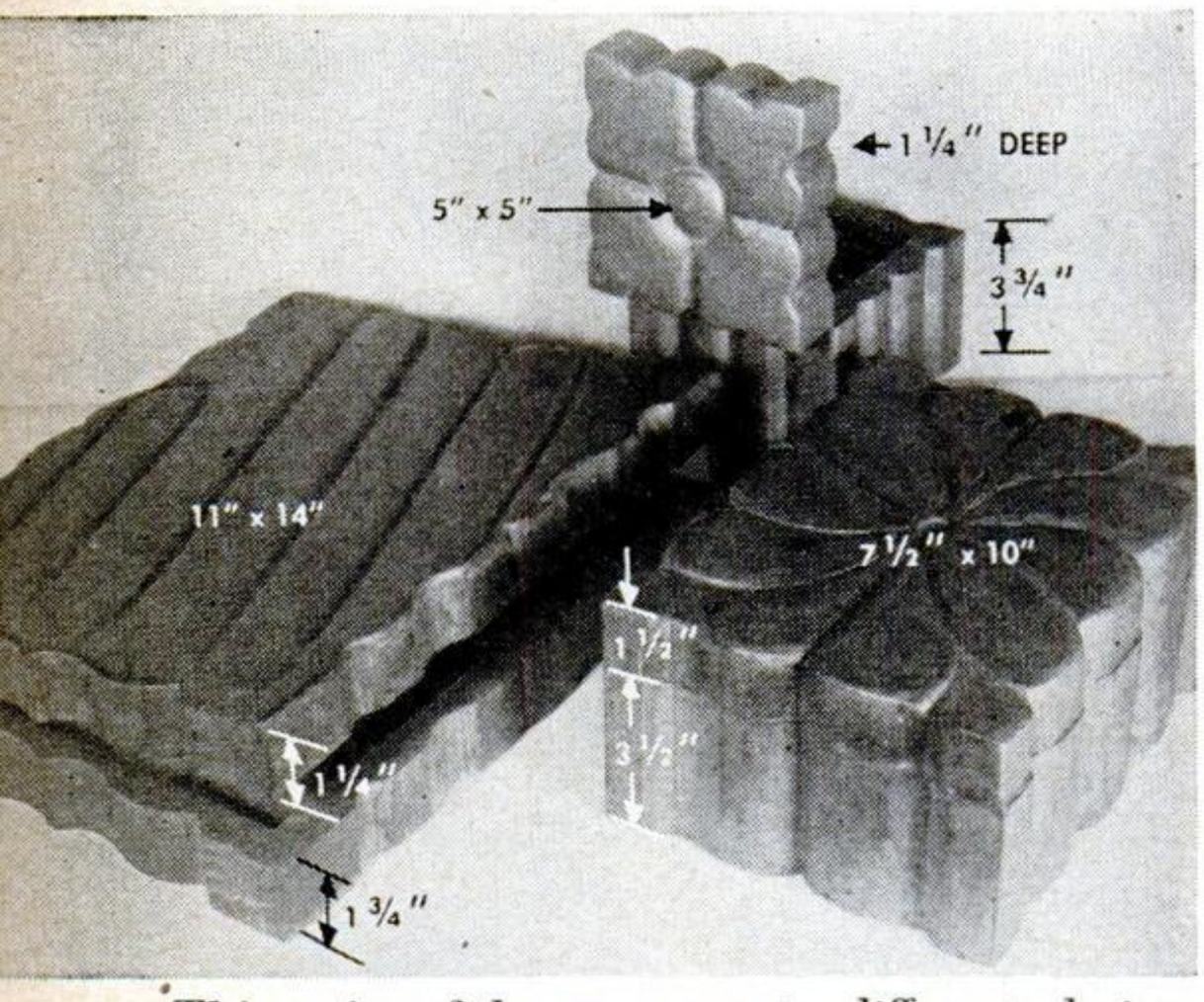
Dresser Box Shaped with Bandsaw

In any woman's room, this handy jewel box gets a place of honor on the dressing table. Notice the crinkly effect produced by a gesso finish.

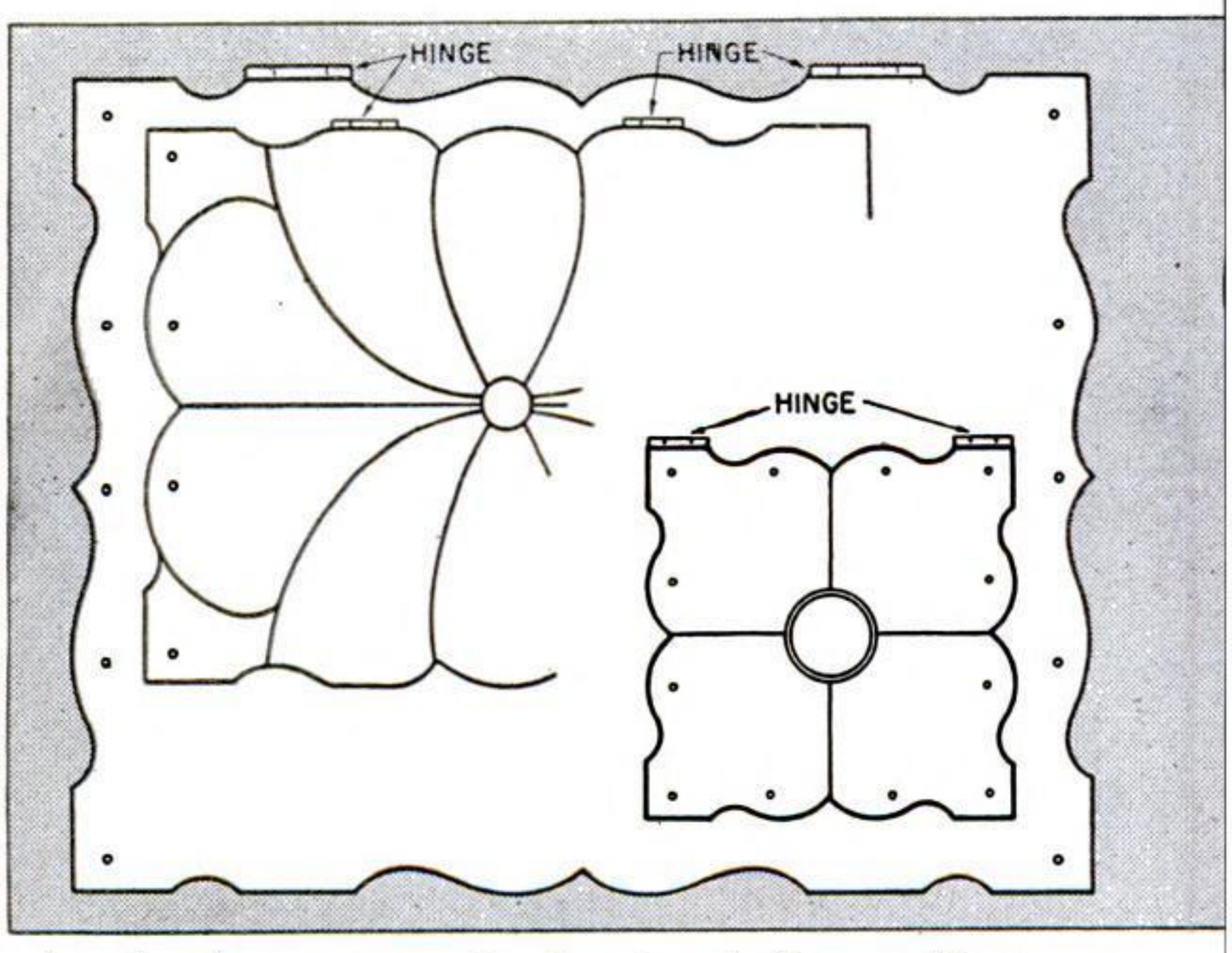
THESE decorative boxes introduce a couple of novel twists. They're shaped with a bandsaw and given a textured finish with several coats of gesso paint.

The basic steps are conventional. You assemble the stock into a closed box with nails and glue and later saw it apart to produce a perfectly fitting lid. Soft wood is the most suitable material. For adequate cutting depth, stock for the sides should be at least ¾" thick.

Before assembling the box, choose your bandsaw pattern and transfer it to the piece of stock that's to be the top. Drive the nails within the pattern, not in the waste.

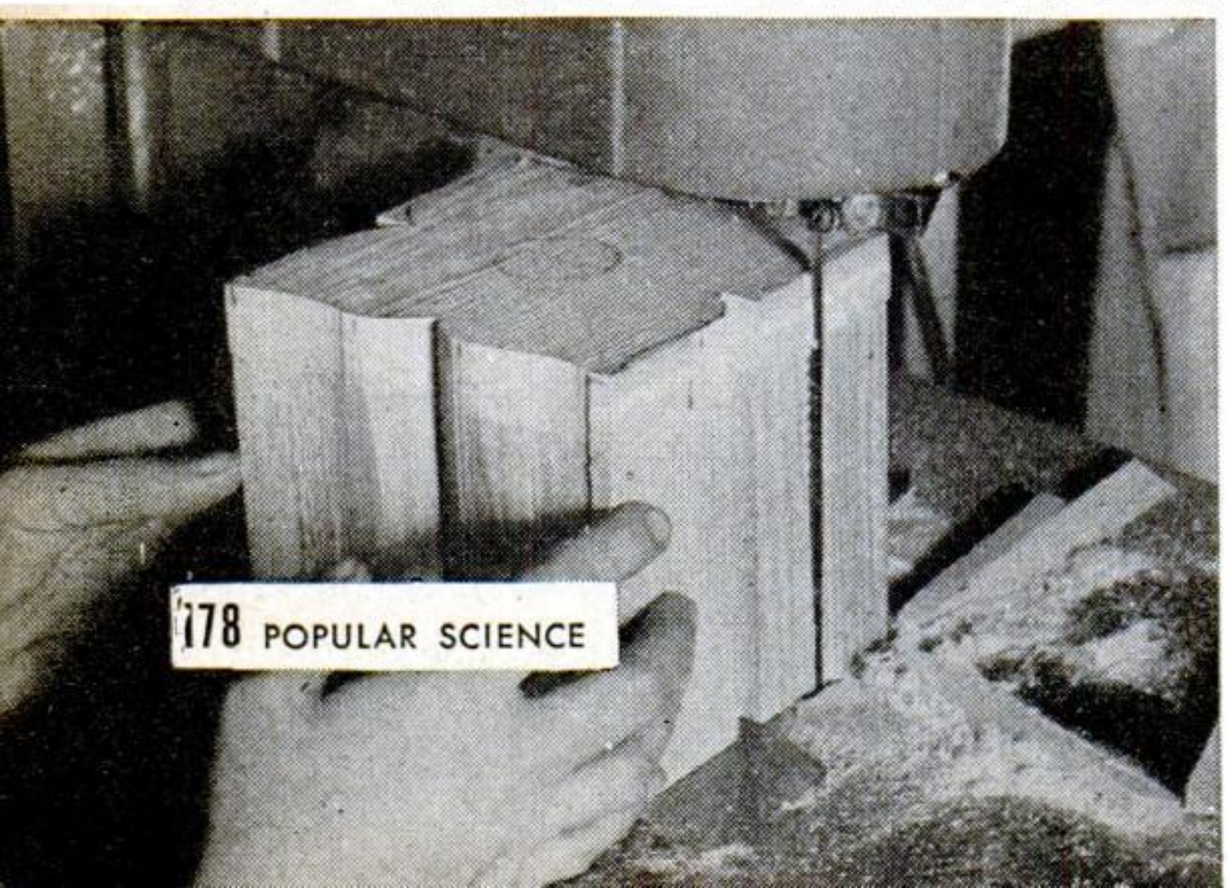


This trio of boxes suggests different designs you can use. The box on right is a sewing kit; the large one is suitable for correspondence.



Apply the pattern to the top before nailing and gluing together the stock into a closed box. These are patterns for the boxes at left.

Bandsaw the box to shape, following an outine traced on the top. After sanding thoroughly, saw the box apart to make the lid and body.



Carving the lid doesn't require the hand of an expert. You can make simple, rough cuts and then finish with fine sandpaper and a file.

After the glue is dry, bandsaw the sides to the pattern applied on the top. Sand the box well before cutting it apart. Fit the lid with brass hinges. An accompanying sketch shows where they may be located.

Boxes of this type are very effective when antiqued with several coats of gesso. Here's how I make gesso:

Dissolve a half cup of powdered or flaked glue in a quart of water over a low flame. Remove from the fire and stir in enough whiting to make a thick, creamy mixture. Dry pigment or metallic powder of any color may be added to this base. Divide the base so you can make several colors.

When cool, the mixture becomes jellylike, but it can be restored to workable consistency by heating over hot water in a double boiler. Apply with a brush. For durability, spray on a final coat of thinned shellac.—*Doris Aller, San Francisco.*

Smooth and round the edges with a file. For an antique effect, apply paint of various colors and rub off most of each coat.

Tiny Model Rides Match Box

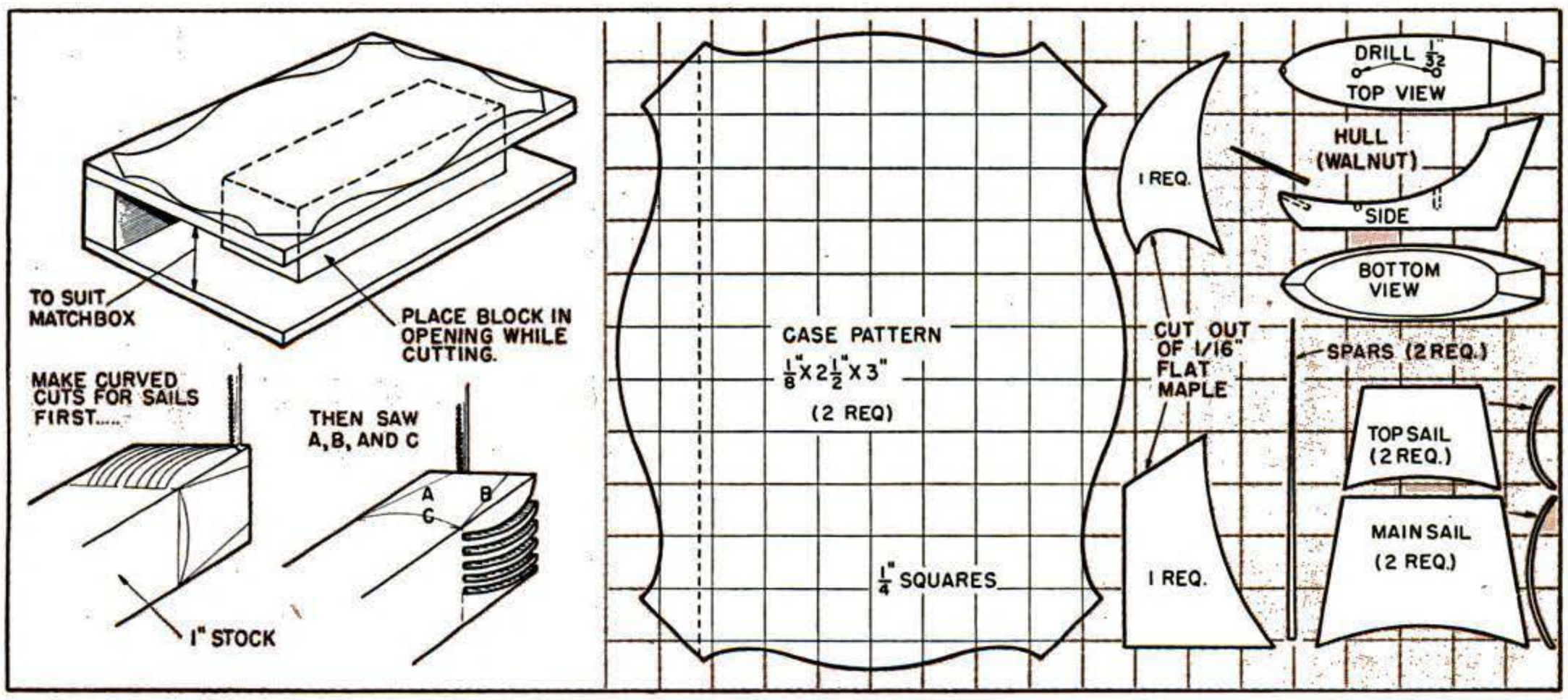
BEFORE you start work on this ornamental match-box case, here's a warning. When your friends see it, they'll probably force you into quantity production.

But if you insist on going ahead, red cedar, walnut, or maple is excellent material for the base. First, glue the top and bottom to the side piece. Then put a spacer block in the slot, transfer the pattern to the top, and cut on a bandsaw or jigsaw, using a fine-tooth blade to minimize splintering.

Make the ship hull of a dark wood so the light maple sails will stand out. Multiple cuts with a jigsaw are a simple way of making the curved sails. Sand all parts smooth before assembly; then cement them together and finish with several coats of lacquer.—*Gus Bouquet, San Quentin, Calif.*

5259

Glue the ship model to the base in a diagonal position. Cement a bit of felt under the case.



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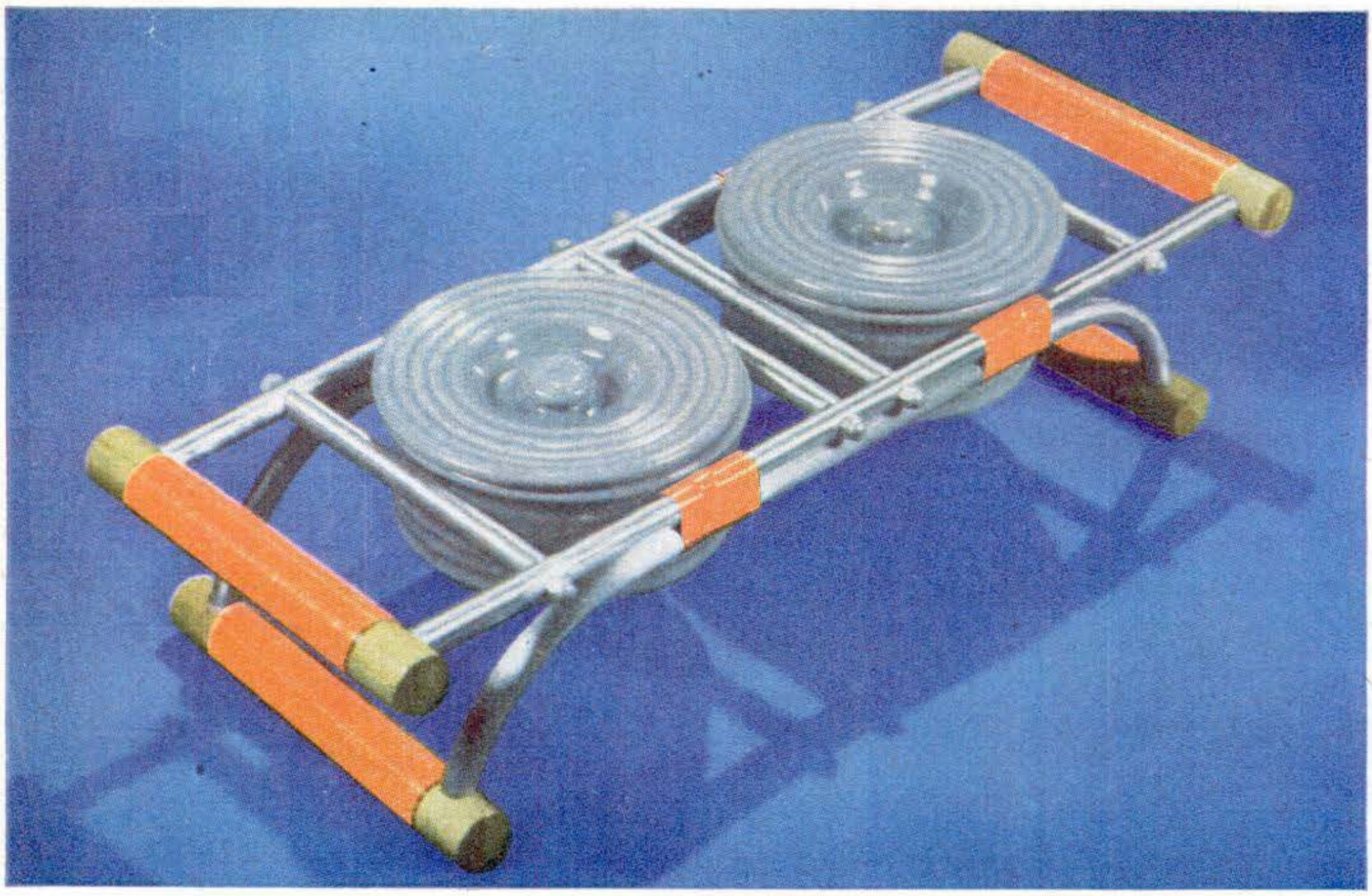
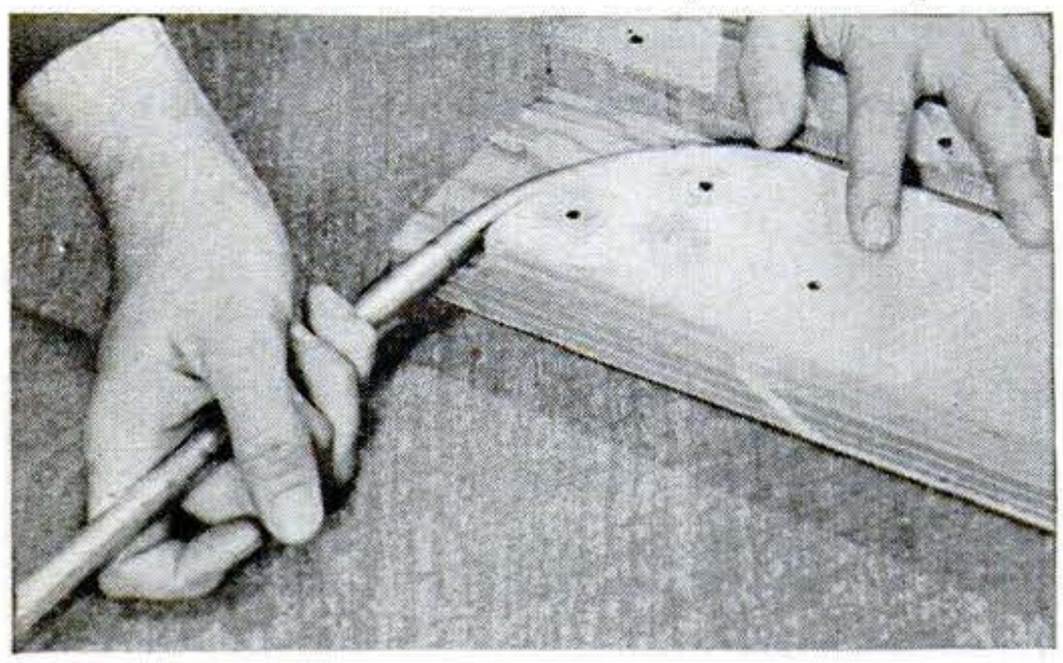


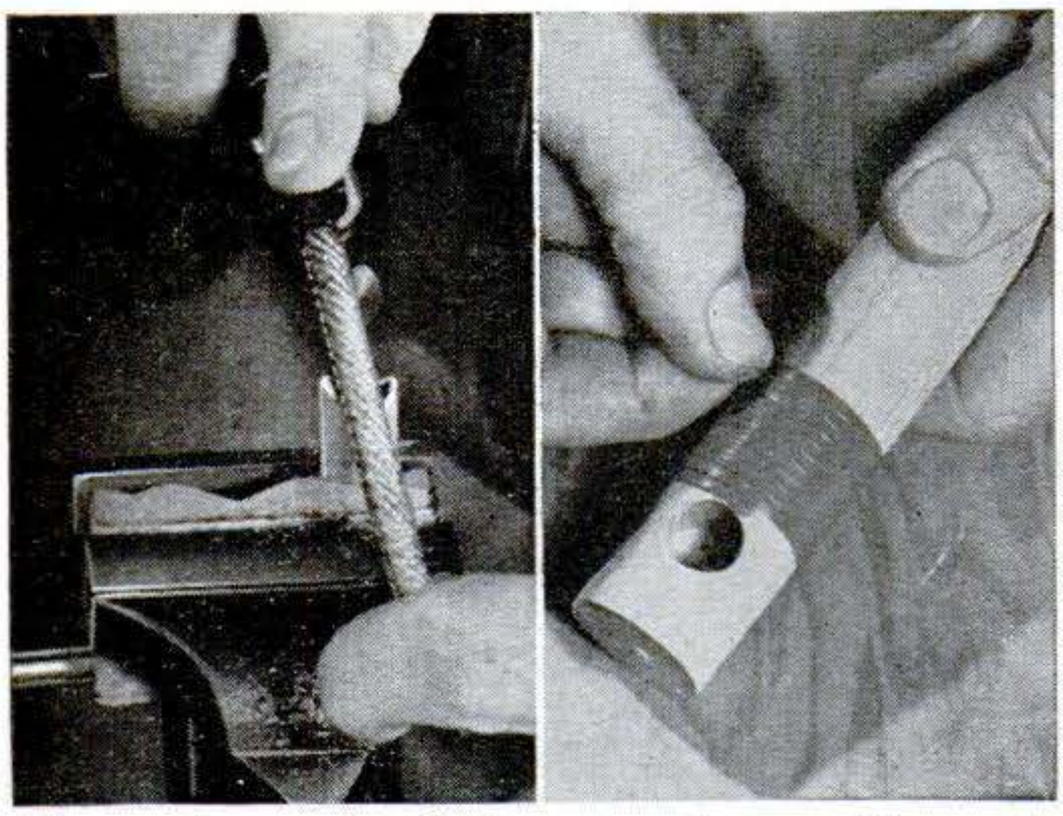
Aluminum and bright plastic cord contrast with the soft tones of the pottery in this rack.

5237

Aluminum Rack Holds Hot Dishes



With a bending jig of scrap lumber, shape the curves of the legs. It is wise to use a paper pattern to check the curves after forming them.



Shape the ends of the crosspieces with a rat-tail file so they fit against the top rails. At right, a finished handle is bound with plastic.

GAILY colored pottery, burnished aluminum, and gleaming plastic combine to make this casserole rack an attractive and useful addition to your table service.

The dimensions are determined by the size of the dishes to be used. The casseroles I used to fit the rack shown here hold up to four servings each. Besides the dishes, you'll need about 8′ of ½″ SO aluminum tubing, a length of 3/16″ rod for draw bolts, eight 10-32 plated cap nuts, and 3′ of 1″ dowel. I found the nuts and tubing at a war-surplus store.

If you vary the dimensions given here to fit different casseroles, lay out full-scale plans—both top and profile—on a piece of paper. For bending the legs, build a jig of scrap lumber, cutting the curved block to a radius slightly less than the final curvature desired.

After bending the legs, check them against your full-size plan. Cut two straight lengths for the upper rails and smooth off the ends

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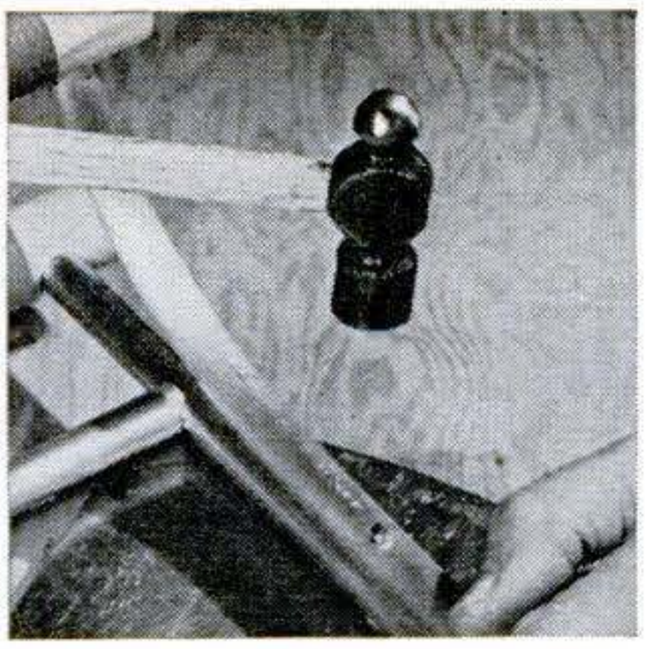
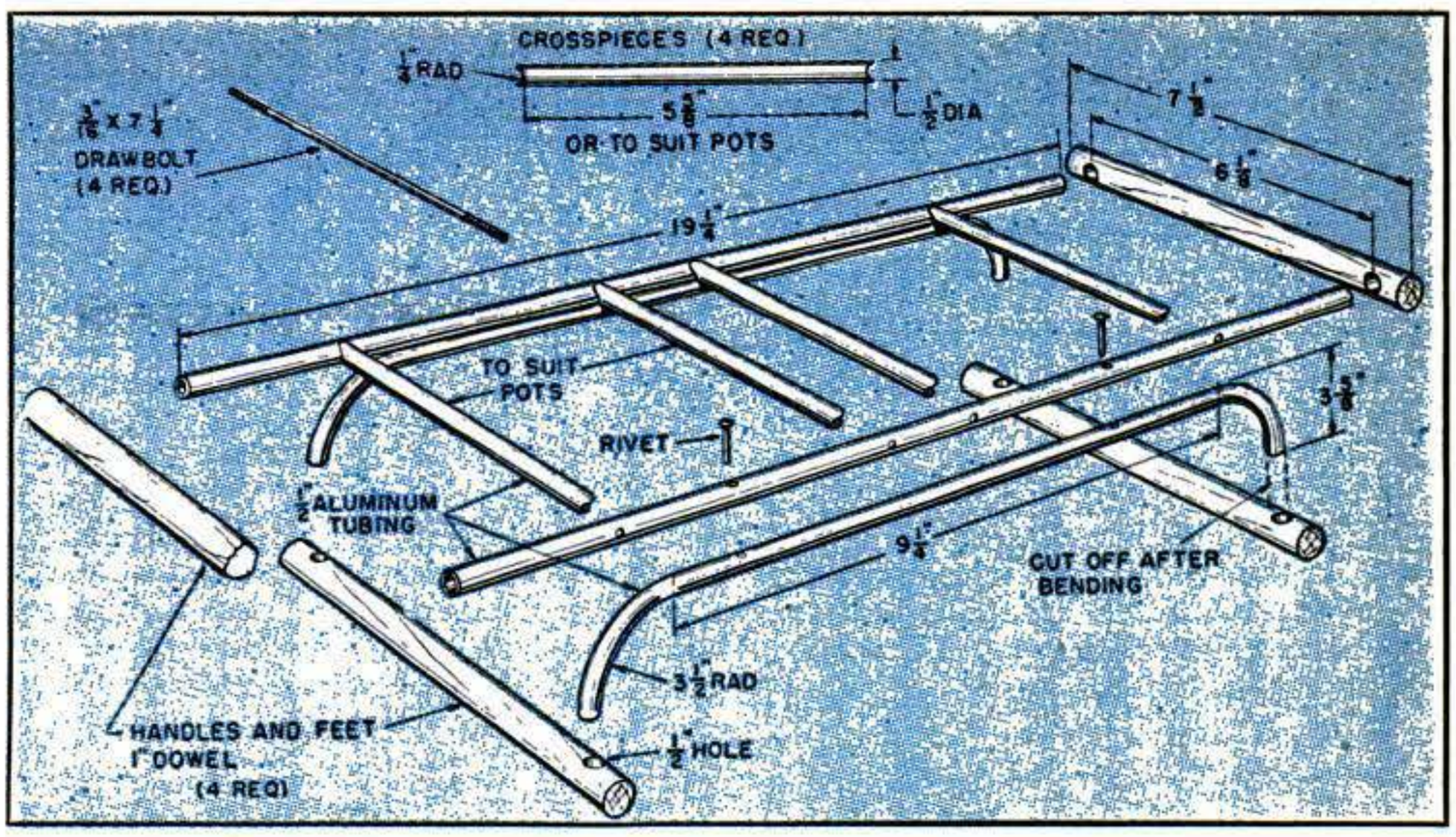


Peen over the ends of the rivets. Then file down close to the tubing so as to avoid bumps under the plastic.



with a file and abrasive cloth. Use a rat-tail file to give the ends of the crosspieces the ¼″ radius shown in the drawing. Be sure all crosspieces are the same length.

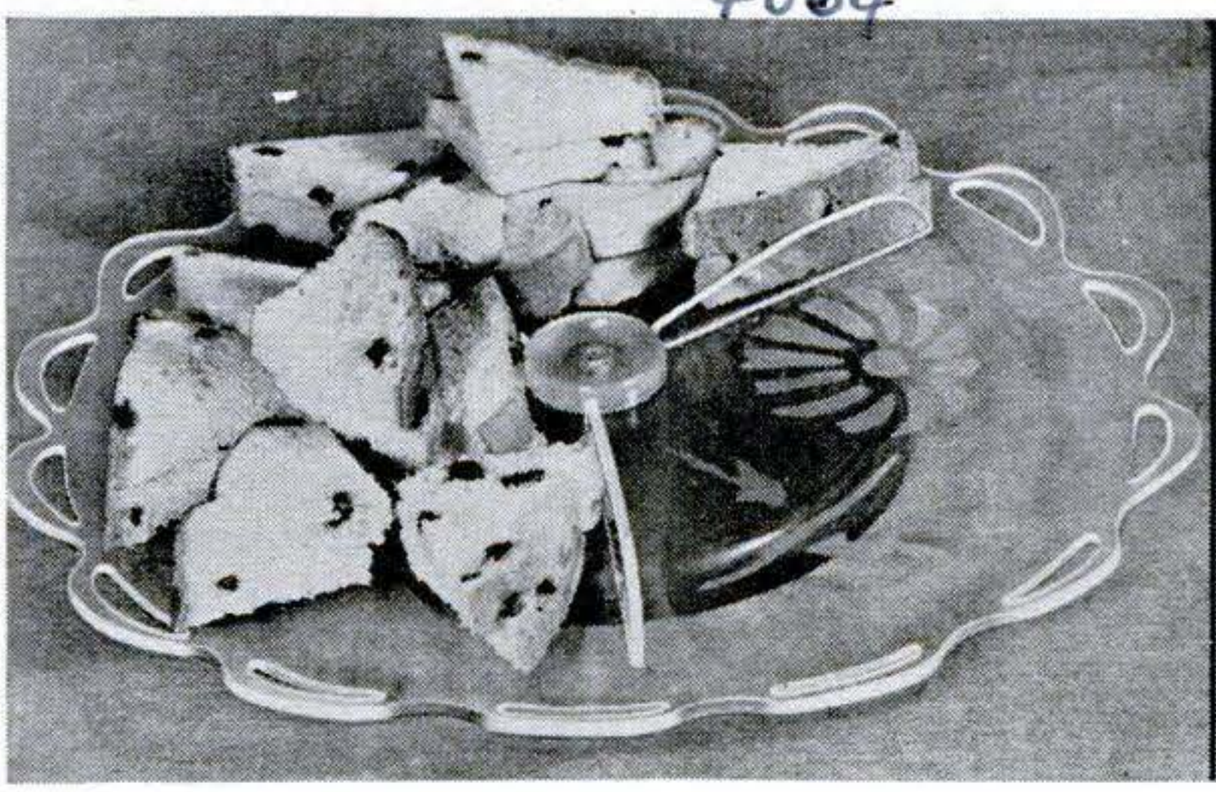
Using medium-fine abrasive paper or cloth, sand each section of tubing with lengthwise strokes. This removes surface scratches and gives a pleasing finish.

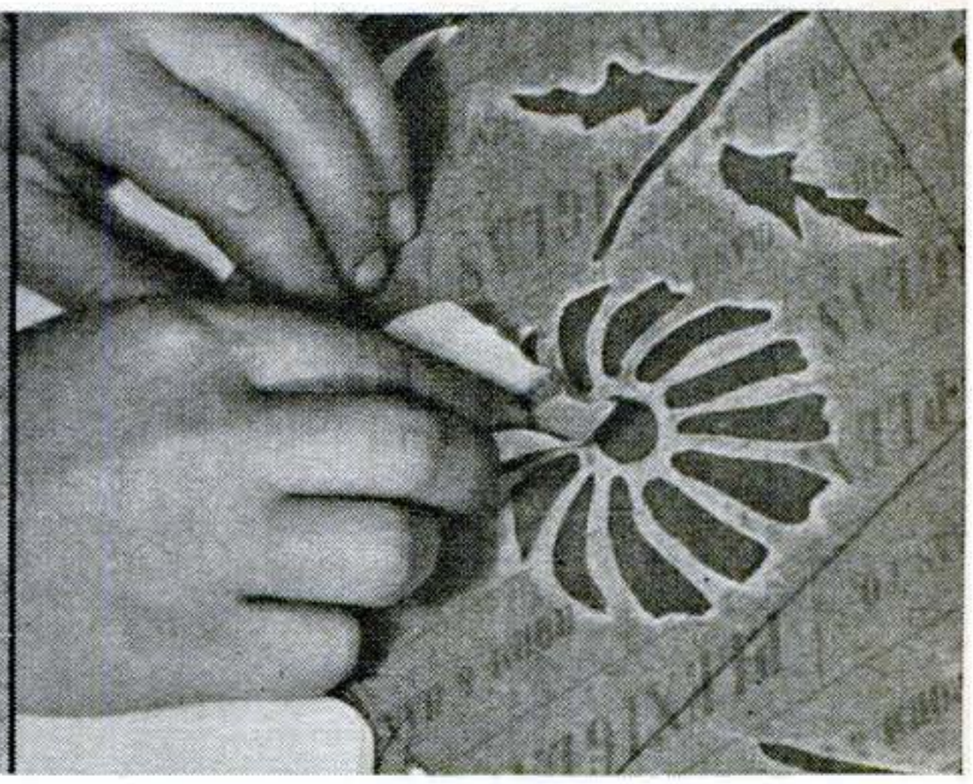
Make the drawbolts from 3/16″ brazing rod, Bessemer rod, curtain rod, or similar material. Cut four identical pieces and thread all ends 10-32. Make the cross handles and feet of 1″ maple dowel, drilling the ½″ holes ¾″ deep. Be sure the holes are perpendicular to the dowel axis and parallel to each other.

Clamp the top and bottom sections together and drill the four rivet holes. After peening over the aluminum rivets, file both ends close to the tubing so that the cord will cover them smoothly. Give the wood and metal a coat of clear lacquer. For wrappings use plastic handicraft cord or copper wire. If plastic cord is used, start and finish the wrapping with a dab of cellulose cement.—*Bill Luther, Los Angeles, Calif.*

Plastic Sandwich Plate Revolves on Wooden Base

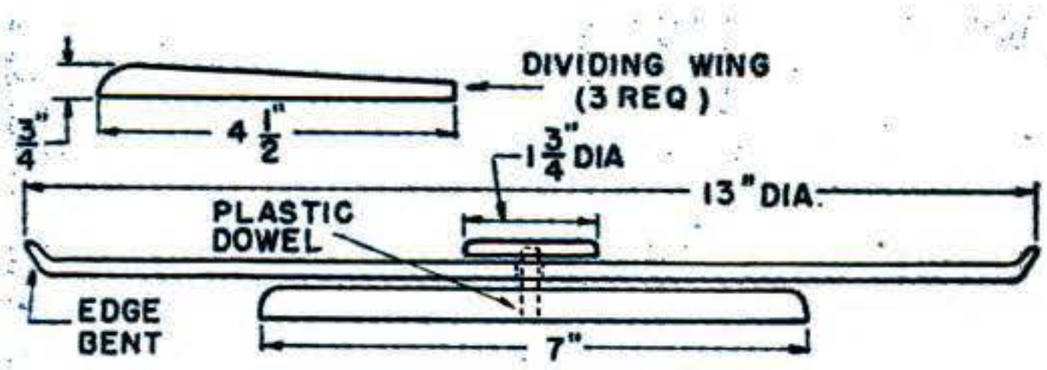
4064





THIS three-compartment server is of ⅛″ clear plastic. Before removing the masking paper, cut out the edges. Then lay out the design in each compartment and with a razor blade cut through the paper around each figure. Peel off this paper, revealing the design as a stencil. Frost the exposed areas by rubbing the plastic with fine sandpaper.

The plate revolves on a short length of ¼″ dowel that is glued into the base. The turned plastic cap—at least ⅜″ thick—is cemented to the top of the dowel. Be careful that no excess cement enters the ⅜″ hole through the center of the plate. Model-airplane cellulose cement will hold the cap on and the three dividing wings fast to the plate.—*Elma Waltner, Hurley, S. D.*



Copyrighted material

5379

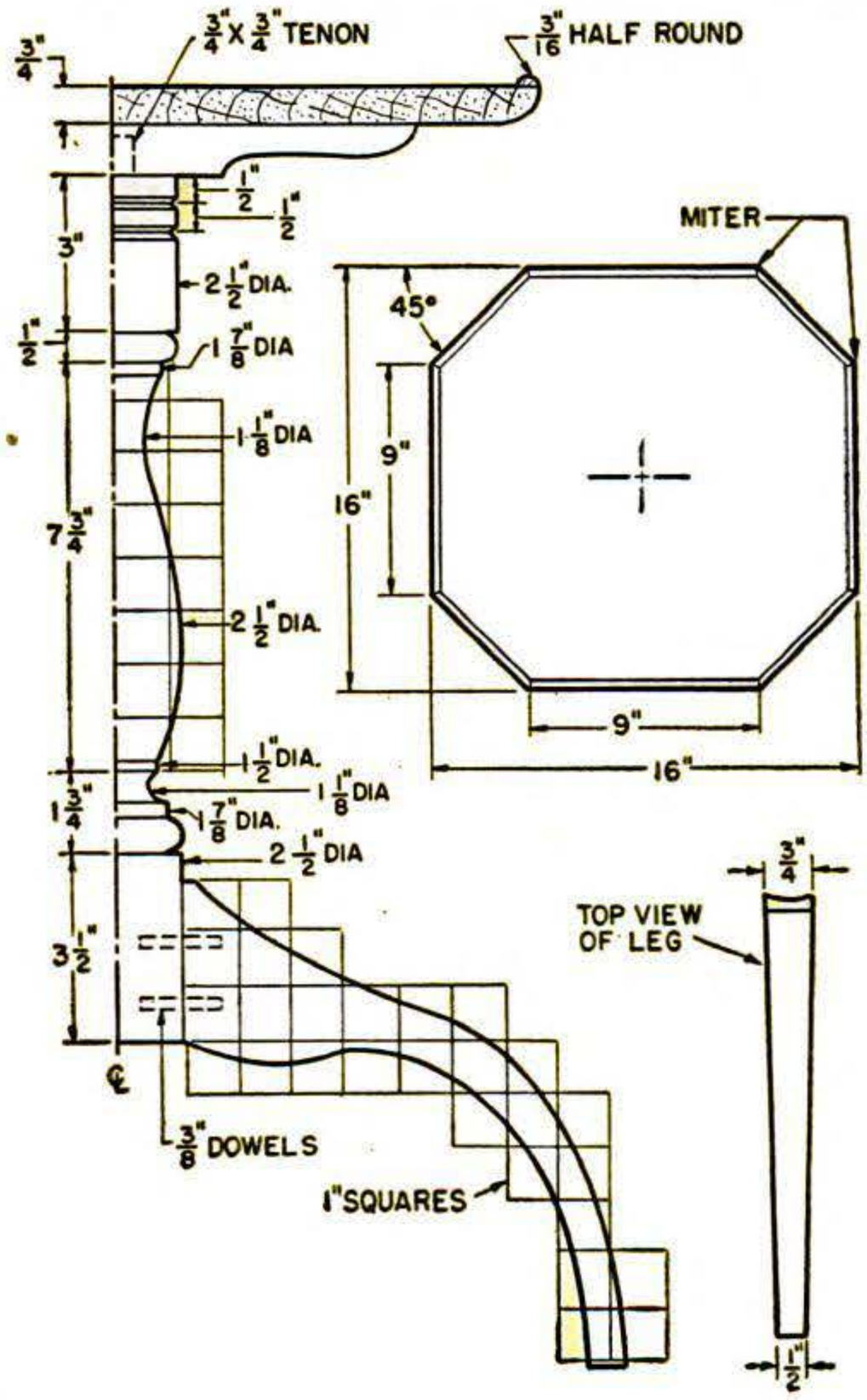
Tilt-Top Table Fits Small Space

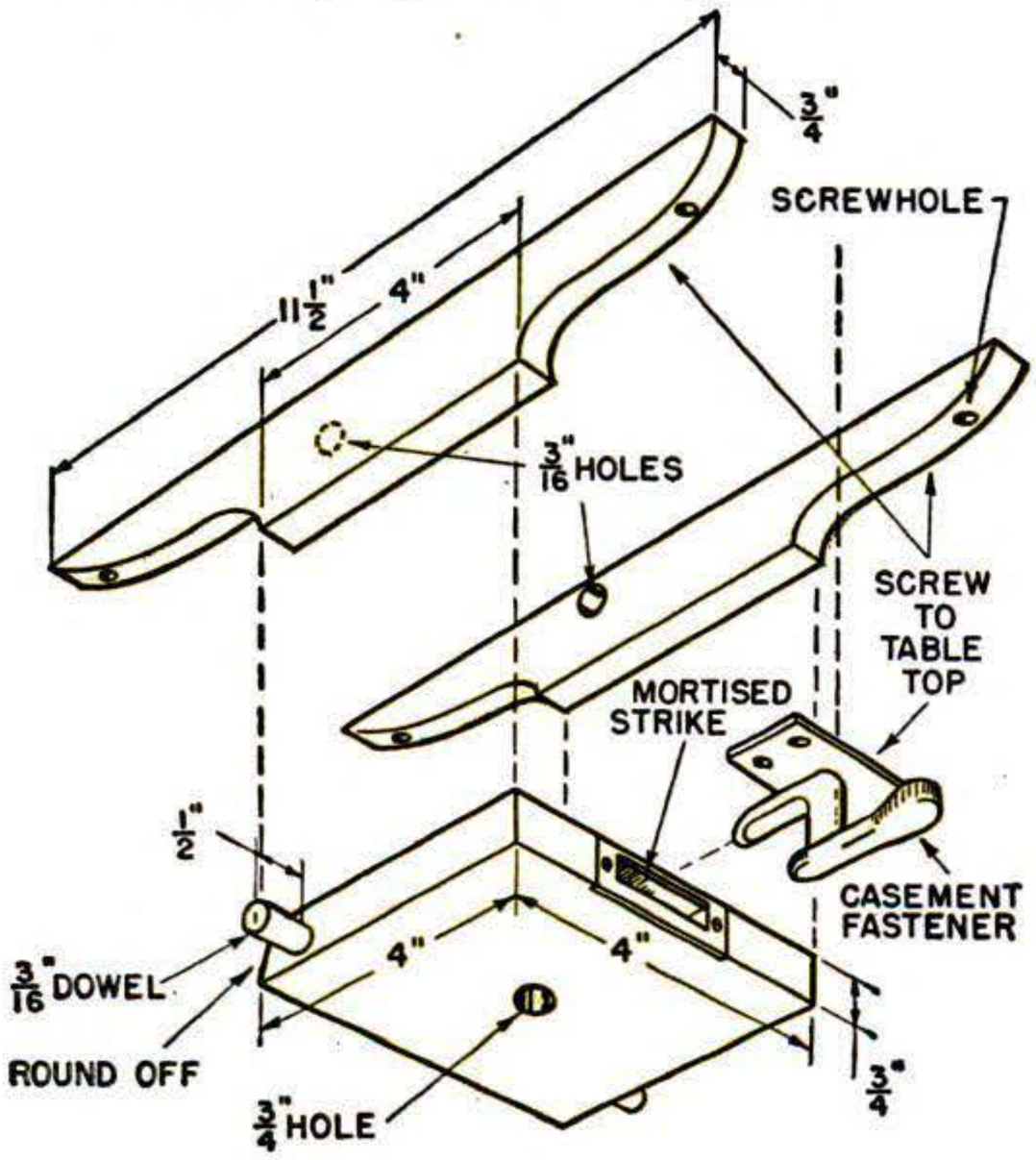
ONE feature of this tilt-top Chippendale table is its size. Dimensions are only about three-fourths those of the customary tilt-top. This reduction makes it good as an accessory piece in a room or apartment where space is at a premium. Either walnut or mahogany is suitable material.

An ordinary casement fastener locks the top in the horizontal position. The table post comes to the center of the 4″ square tilting block. A ¾″ by ¾″ tenon on the post holds the two pieces together. Round off the swivel edge of the block to get clearance for tilting.

The top pivots on two 3/16″ dowels. These are set in holes drilled part way through the two 11½″ brackets that are screwed under the top. Install this entire assembly so the casement-fastener tongue moves freely but firmly into the mortised strike.

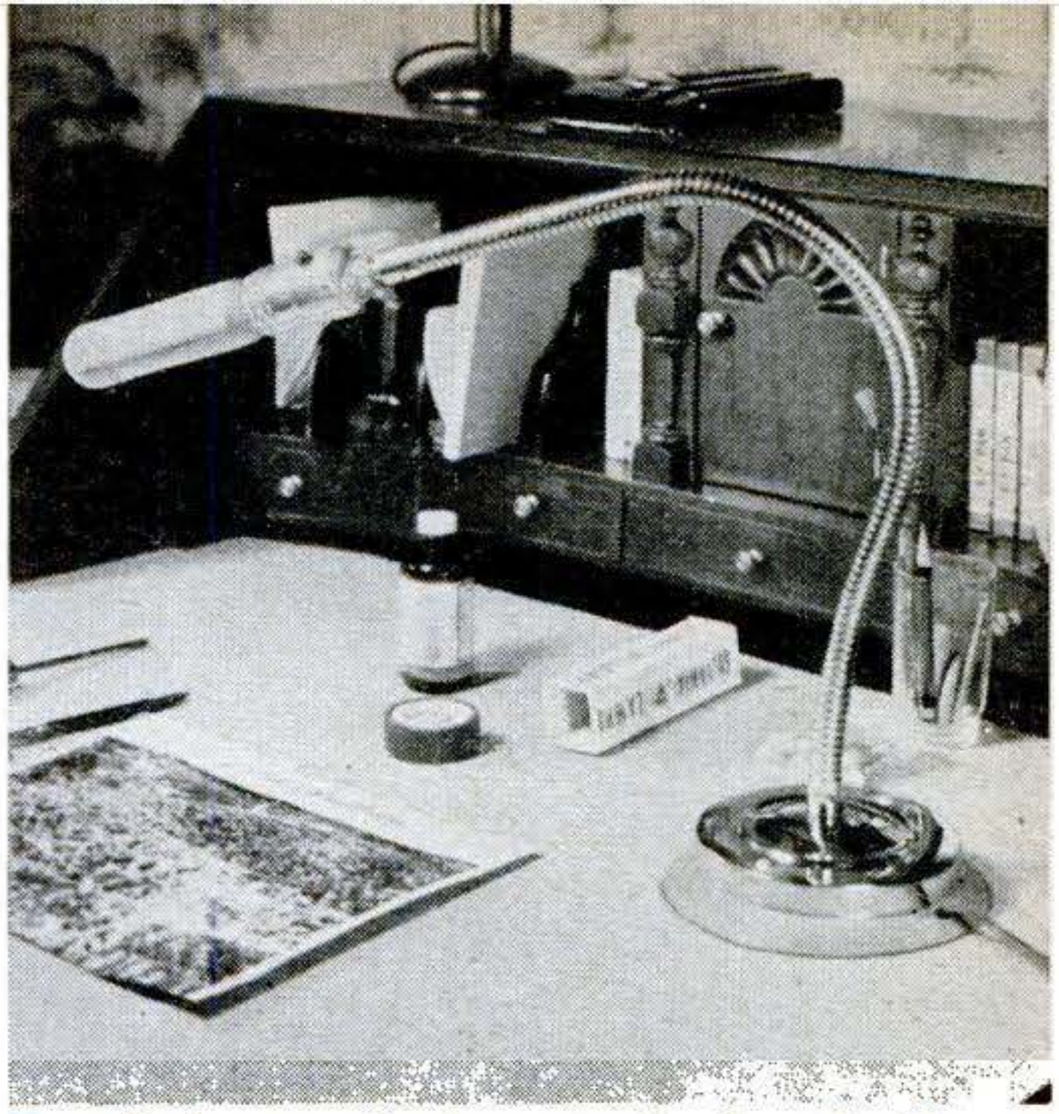
Taper the legs from ¾″ to ½″ and drum-sand the vertical edge to a concave section for a perfect joint with the post. A mitered 3/16″ half-round molding borders the top. —*Norbert Engels, South Bend, Ind.*





Copyrighted material

Double-purpose lamp of gleaming chrome has 24″ gooseneck, and serves as wall or desk light.



For desk use, the lamp is fitted with 40-watt showcase bulb that has a built-in reflector.

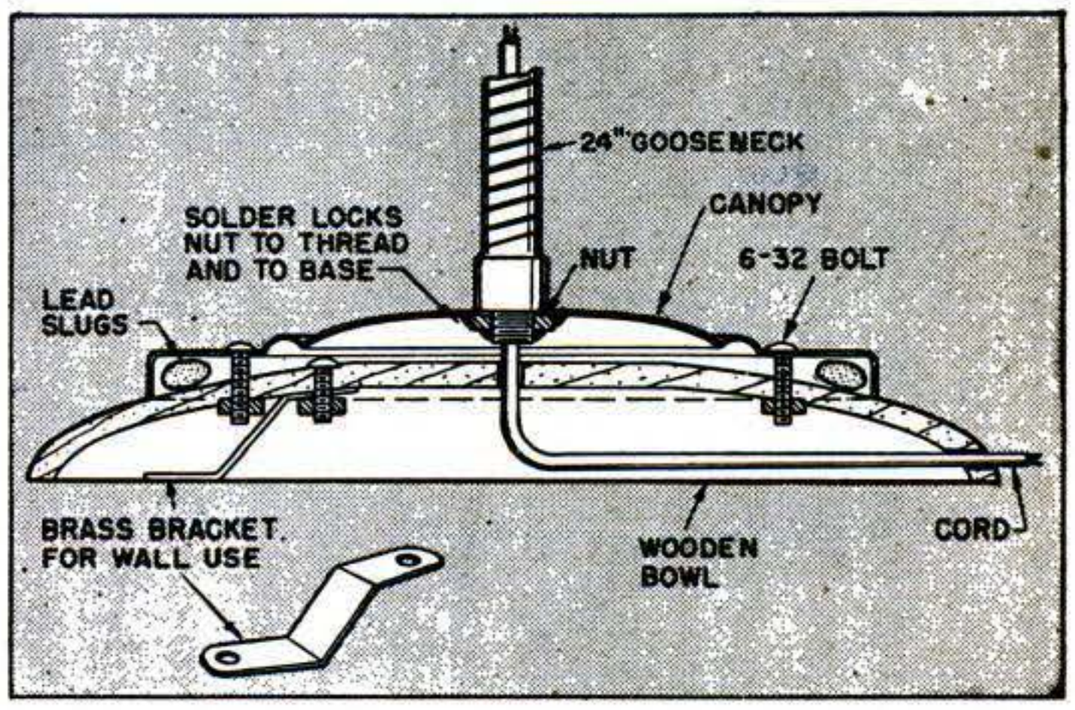
Gooseneck Lamp for Wall or Desk

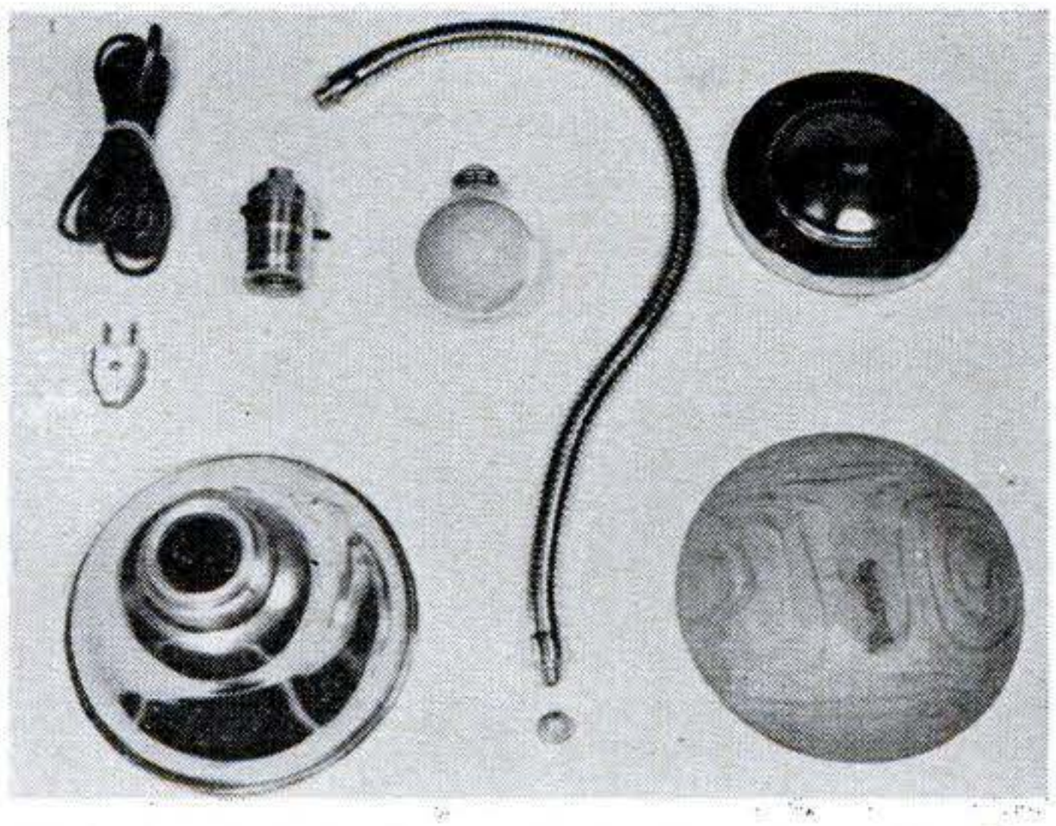
S-405

By careful shopping, I bought the parts for this combination lamp for less than $5. Simple to assemble, it calls only for common hand tools. Here's what you'll need to duplicate it:

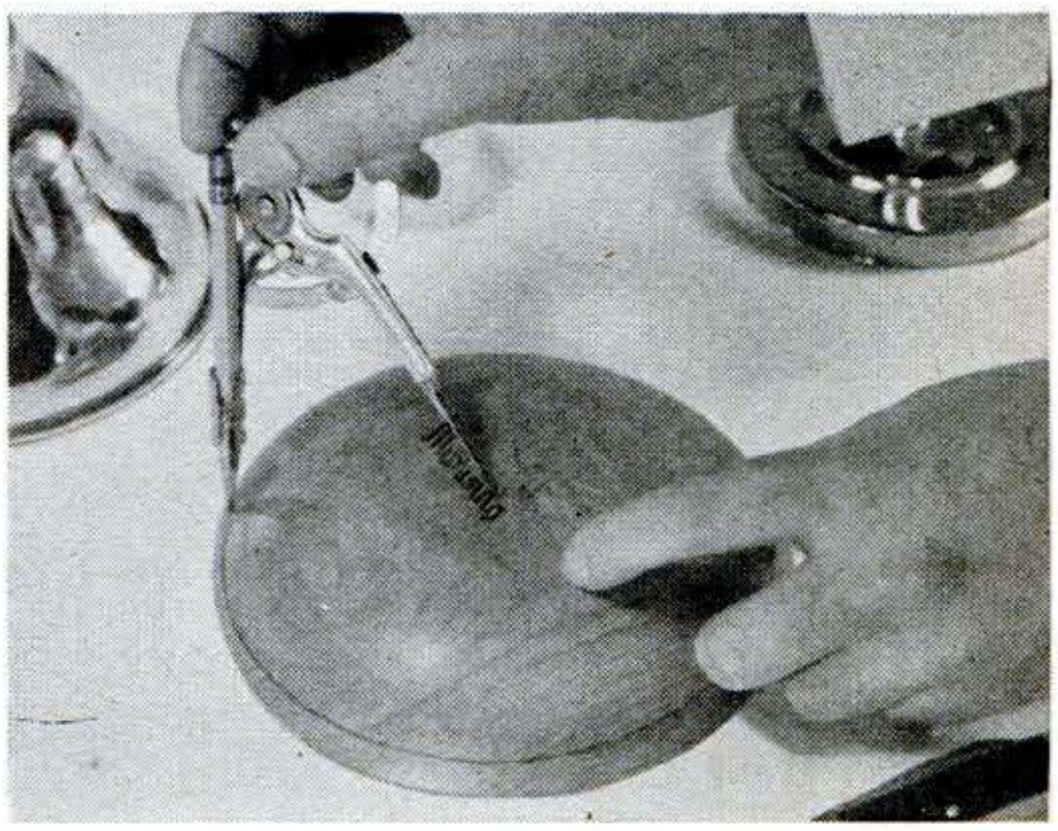
A small wooden salad bowl; a chromium-plated gooseneck 2′ long; a lamp cord and plug; a nut to hold the gooseneck to base; and a chromium-plated socket, ceiling canopy, and reflector.

If the wooden bowl is too large, cut it down. Then drill these holes: one in the center of the bowl for the gooseneck; two on opposite sides of the bowl to bolt it to the canopy; matching holes in the canopy; and a hole near the edge of the bowl for the cord. The diagram at right shows you where to locate these holes as well as how to attach the wall bracket. For desk use, weight the base with lead fishing sinkers.—*William Norton, Manhattan, N. Y.*





Only nine parts, not including brass bracket for wall use, are all that go into the lamp. In this photo, bowl already had been trimmed.



If wooden bowl for the base is too large, use a compass to lay out a 6¼″ circle on the bottom, and then cut around line with keyhole saw.

Copyrighted material

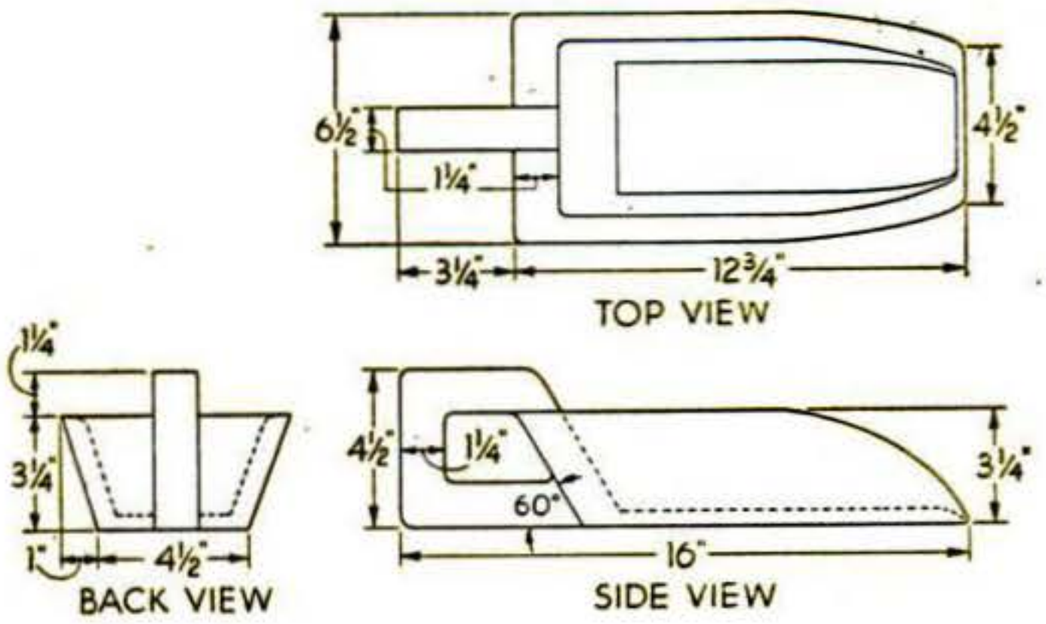
Laden with fruit or flowers, this roughhewn redwood scoop forms a handsome centerpiece.

4044

Scoop Server Carved from Redwood

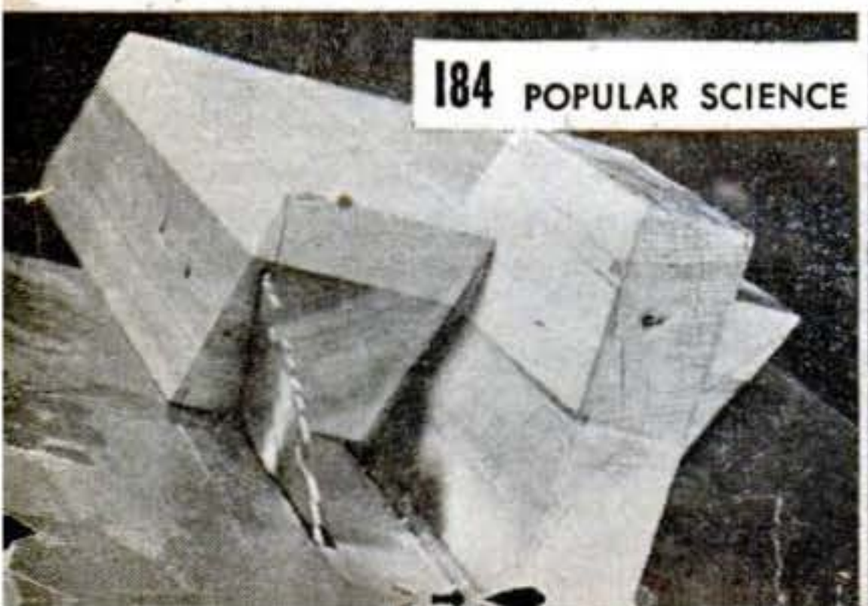
HERE'S a piece that looks as if it had been turned out by an old-time craftsman. Despite that, power tools will save you much of the labor needed to carve it out.

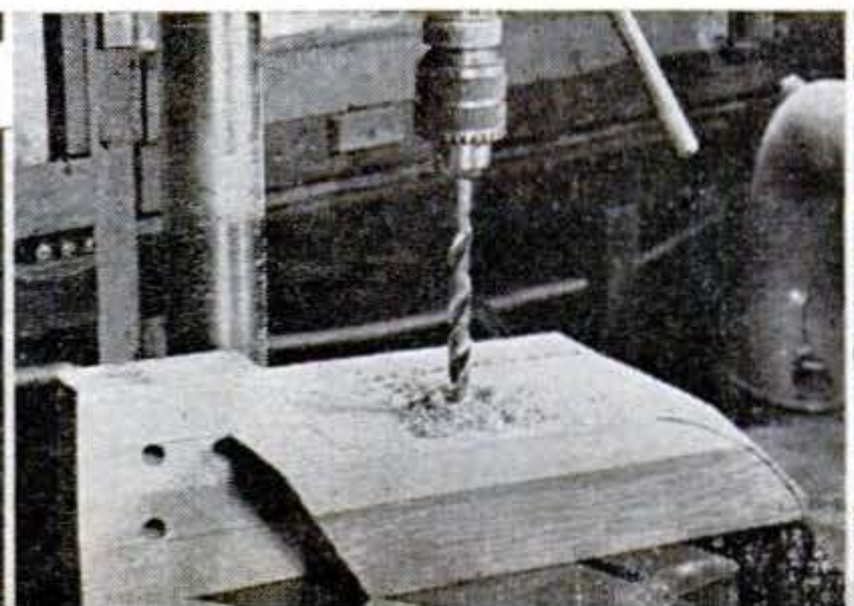
Begin by gluing up a 4½" by 6½" by 16" block of redwood or pine. Lay out the outlines on the sides of the block and cut the profiles on the circular saw. A few cuts may have to be completed by hand. The finger hole in the handle is made with a coping or keyhole saw.



You can use a drill, Forstner bit, or router to remove most of the wood from the center of the scoop. Complete the job with gouges, chisels, and sandpaper, rounding all edges. The trick is to use the bench tools to remove all signs of power tools, and when sanding to leave traces of the chisel and gouge planes. A natural-color finish, with pumice and oil or clear shellac, is probably best, though a light stain might be suitable. Finally, polish with wax.—*Doris Aller, San Francisco, Calif.*

Rough out the scoop on the circular saw, tilting the table for angle cuts. Much of the wood in the center may be drilled out. Note the holes drilled in the handle for inserting a coping-saw blade. Cut out the remaining waste with chisels and wood-carving tools, rounding all edges.

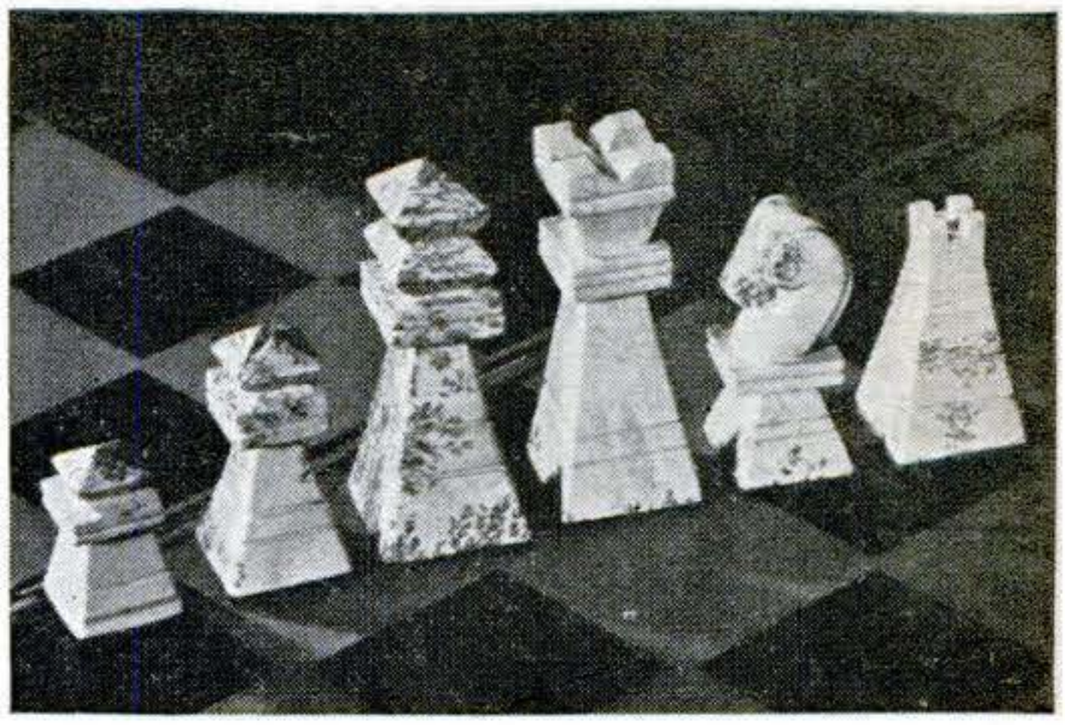




4196

Chess Set Is Carved from Steatite

Sculpstone, Inc., 178 Suffolk St New York

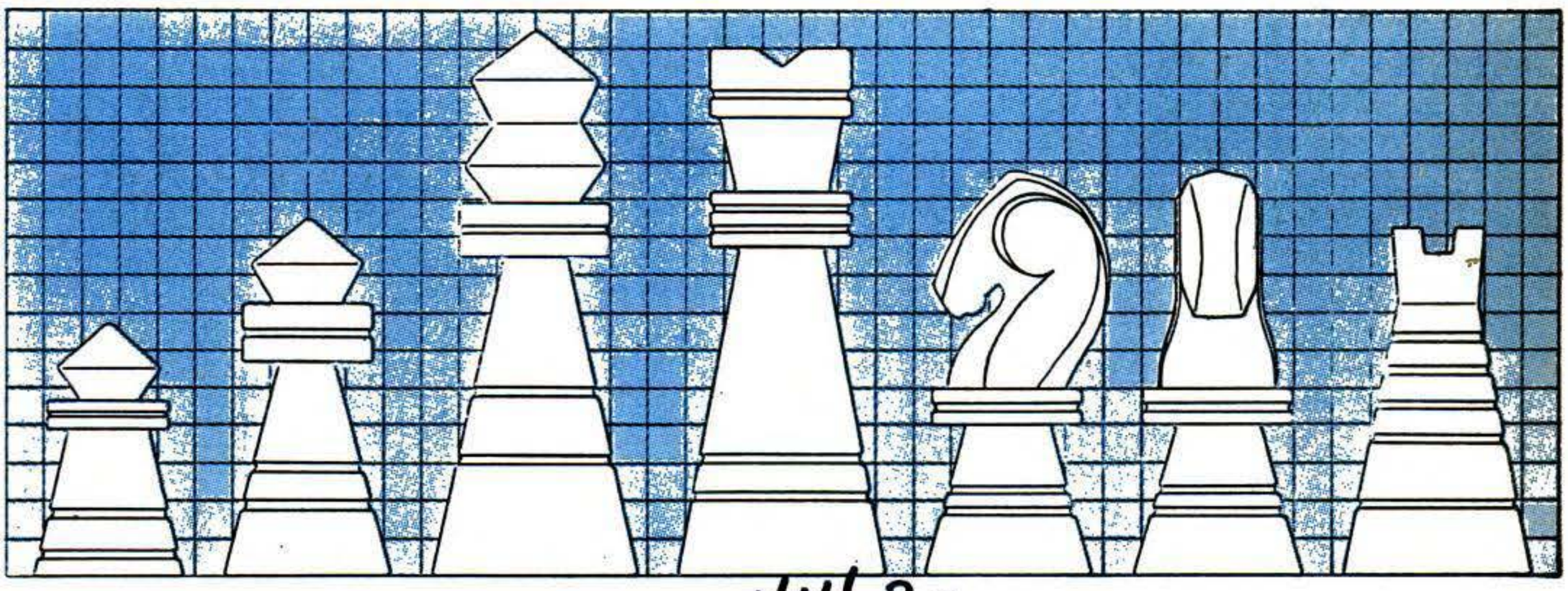


Not too far in design from classic chess shapes, this set is unusual in that it is made entirely without a lathe. The square-based pieces are sawed and carved from Sculpstone ®, a form of steatite sold for handicraft uses.

Pleasing to the touch, this material is excellent for chessmen. It's soft enough to be worked with simple hand tools—a scraper, penknife, or even a nail file. There's also sufficient weight to give a nice heft and good stability on the board. Sculpstone comes in various colors, and you will of course want both light and dark stock.

Since chessmen are made in many sizes, no dimensions are given. However, the drawing below shows relative sizes, and is about right for a standard board.

Rough-saw the blocks to size, saw the side tapers, and complete the carving with knife and scraper. Smooth the finished pieces with fine steel wool and apply oil to bring out the tone. The surface can be made scratch-resistant with a plastic hardener.

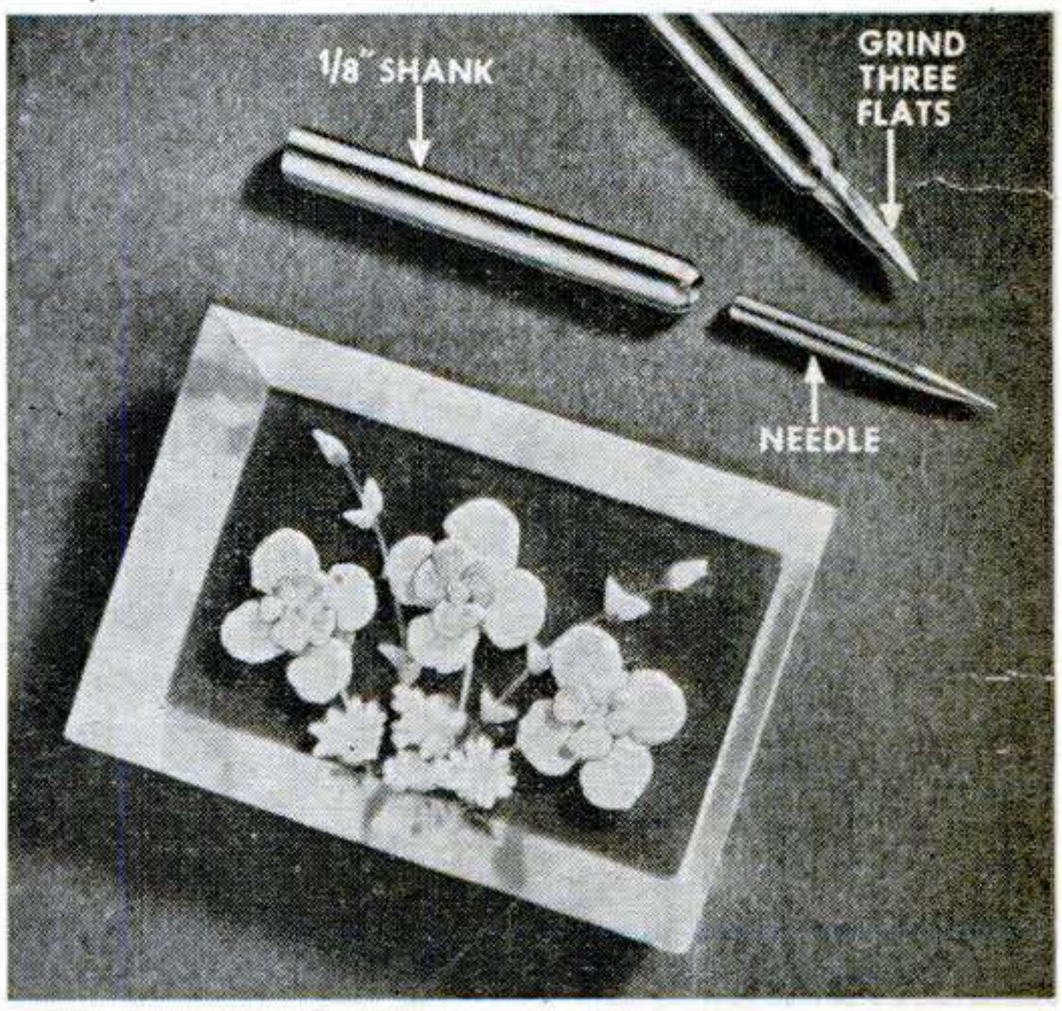


4462

Internal Carvings Made with Phonograph Needles

If you'd like to try miniature internal carving of plastic, try cutting tools ground from phonograph needles. I developed these after making an unsuccessful search for really small cutters. I first ground three sides to the needle point, and then inserted the shank of the needle snugly into a hole drilled in the end of a 1″ length of ⅛″ steel. A collet to hold the 1/16″ needles can be bought if you prefer.

In grinding, hold the needle in a pin vise and use a small wheel to form the flats. These should be equal in width, and may be hollow ground (slightly concave) to make the edges sharper. Be careful not to overheat and soften the fine point.—*Erwin S. Plavec, Chicago.*



Copyrighted material

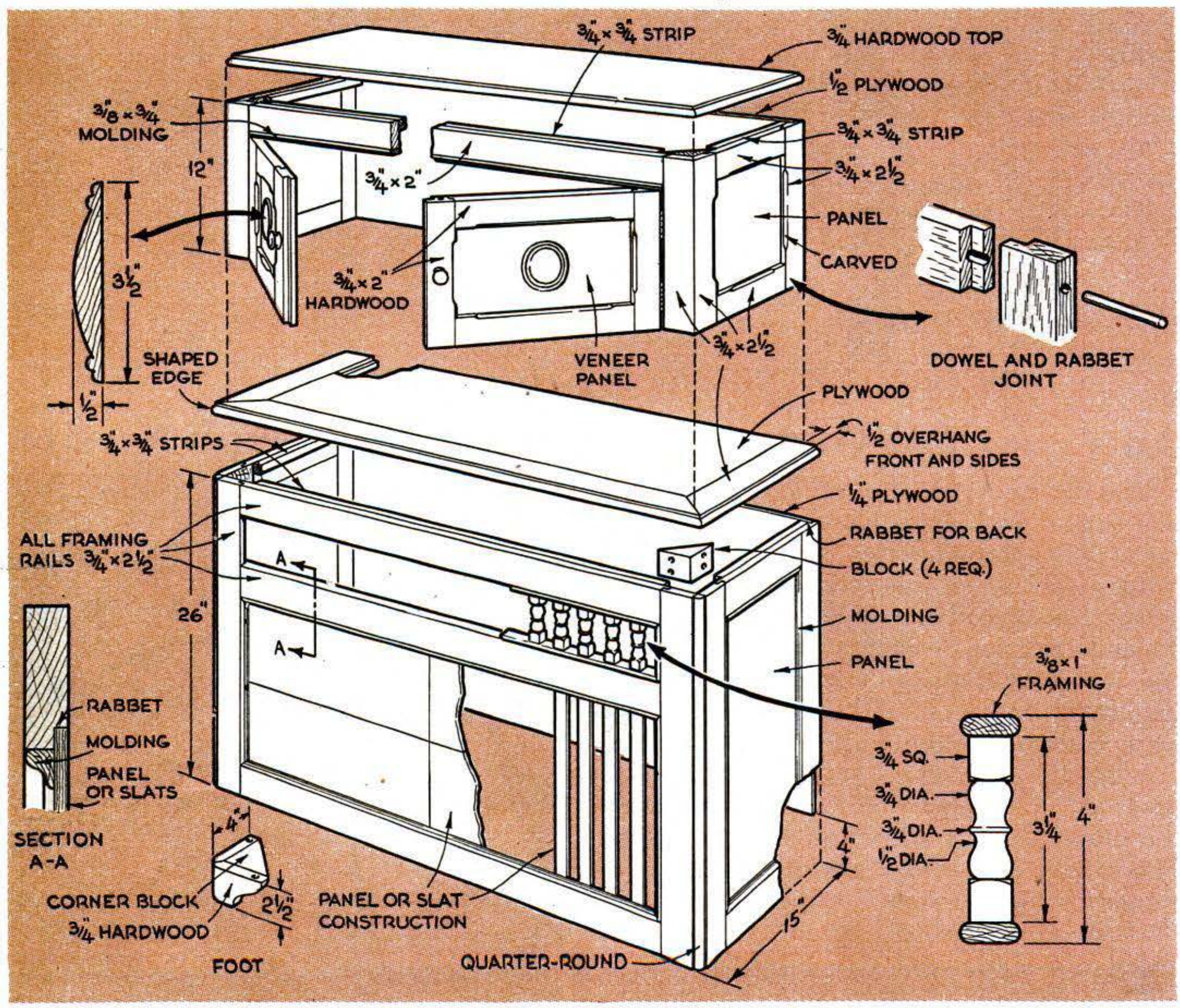
3092 6030

Beauty and utility are combined in this radiator cover and hall chest of natural-finish oak.

Turning Radiators into Furniture

Enclosures of the right kind disguise these ugly ducklings as useful pieces without stifling heat circulation.

WITH the end of warm weather in sight, this is the time to build radiator covers. But before deciding on a design, consider how the cover will affect the heating effi-



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ciency of the radiator. A properly designed and constructed enclosure will pay off in appearance plus a more comfortably heated room. The wrong cover will cost you wasted fuel, to say nothing of the discomfort of a poorly heated room.

You'll be safe in following these two general rules: Stay away from covers that solidly enclose too much of a radiator's heating surface. At the same time, avoid enclosures that fit too loosely. University of Illinois engineers, experimenting in a temperature-controlled building with various types, found that snug-fitting enclosures—everything else being equal—were more efficient.

Here's another tip: Build your covers with protecting backs. The experimenters tested both a bare radiator and an enclosure with no protecting back. They checked the temperature of the inside surface of the wall just behind both. In both cases it ranged from 116 to 121 deg. F. Then they installed a back in the cover and the temperature at the same spot dropped to 76 deg. F., indicating a considerable reduction in heat loss through the wall.

Many radiators are located beneath windows, and here again an enclosure pays off. A solid top on the cover deflects the warm air out into the room, preventing it from rising straight up to pass over the cold panes and consequently to lose heat.

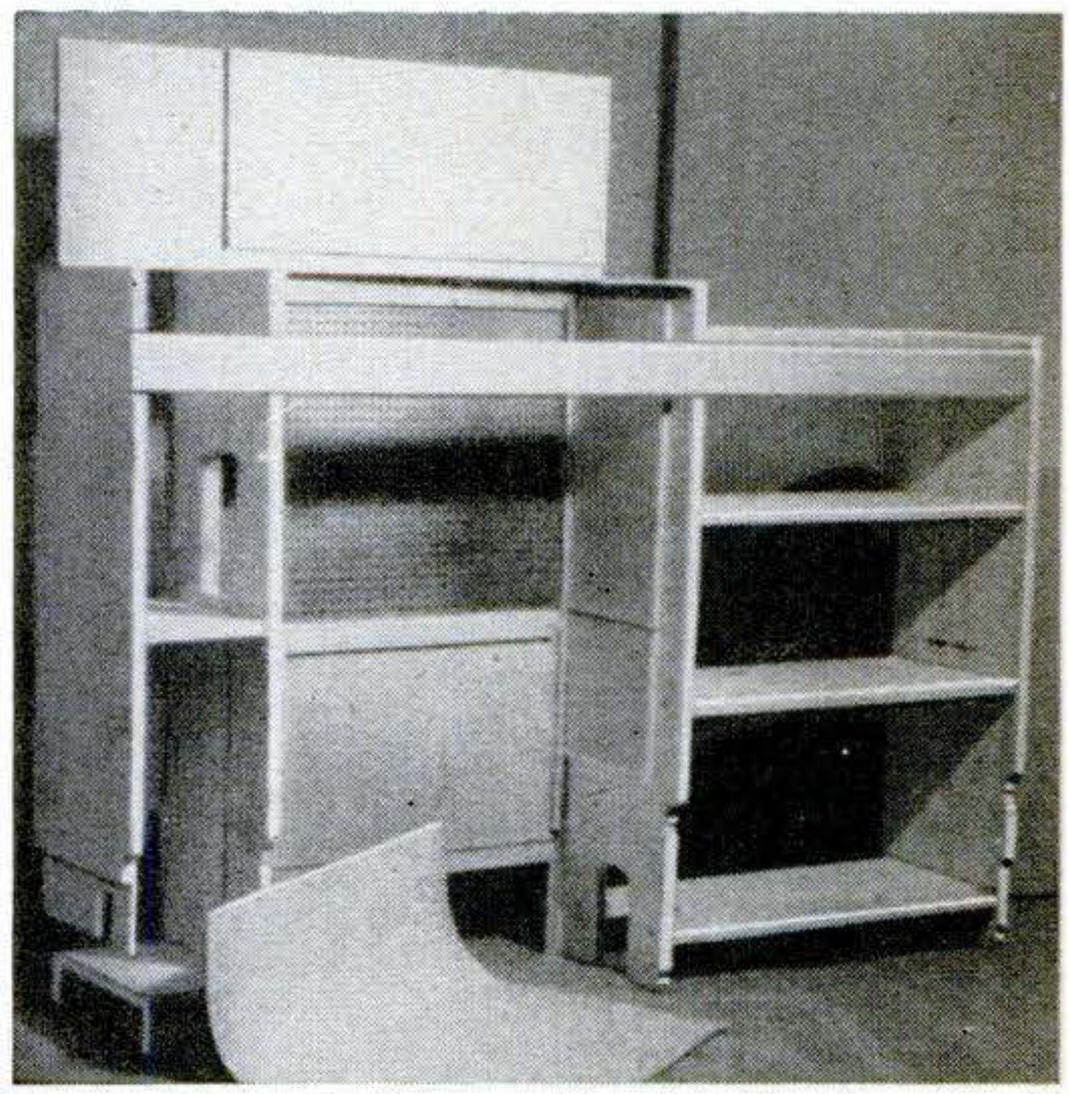
The inside of enclosure backs and tops should be insulated. You can use asbestos sheeting as shown in the photograph, but better still is sheet metal or heavy cardboard curved over the top of the radiator and down the back. If cardboard is used, glue aluminum foil to the surface facing the radiator. You can buy the foil in rolls in most houseware stores.

The over-all dimensions of a cover are governed, of course, by the shape of the radiator. Select a wood and finish to harmonize with the other furniture. The bedroom cover shown here was built of softwood finished in white enamel. Softwood also was used in the living room, but with a mahogany stain. The hall cover and chest were made of natural-finish oak.

With all the covers described here, a desirable modification probably would be the use of slats or metal grille in the ends. This would expose more heating surface to air circulation. You also may want to include a small hinged door in an end for access to the valve.

In building the combination hall cover

Photos on this page show what a little ingenuity will do in building a radiator cover.



Rear view of the combination bookcase and cover. Note how legs are cut to fit baseboard.

Completed project has space for books on both sides of radiator. Radio fits in shelf at left.

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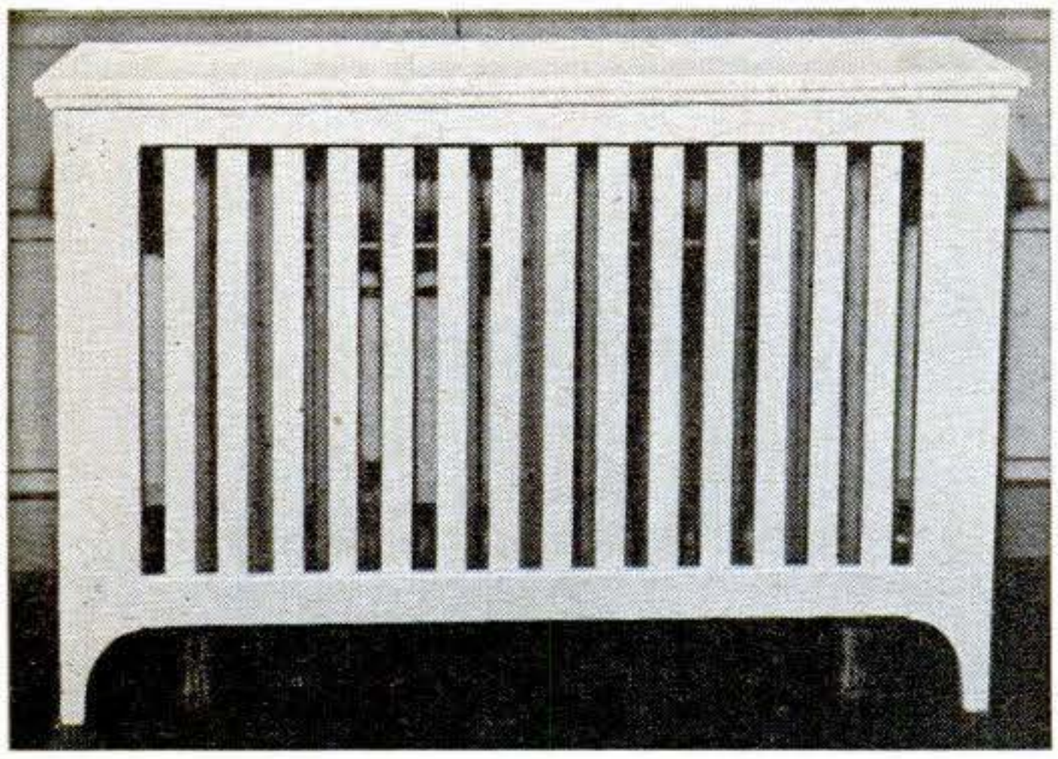
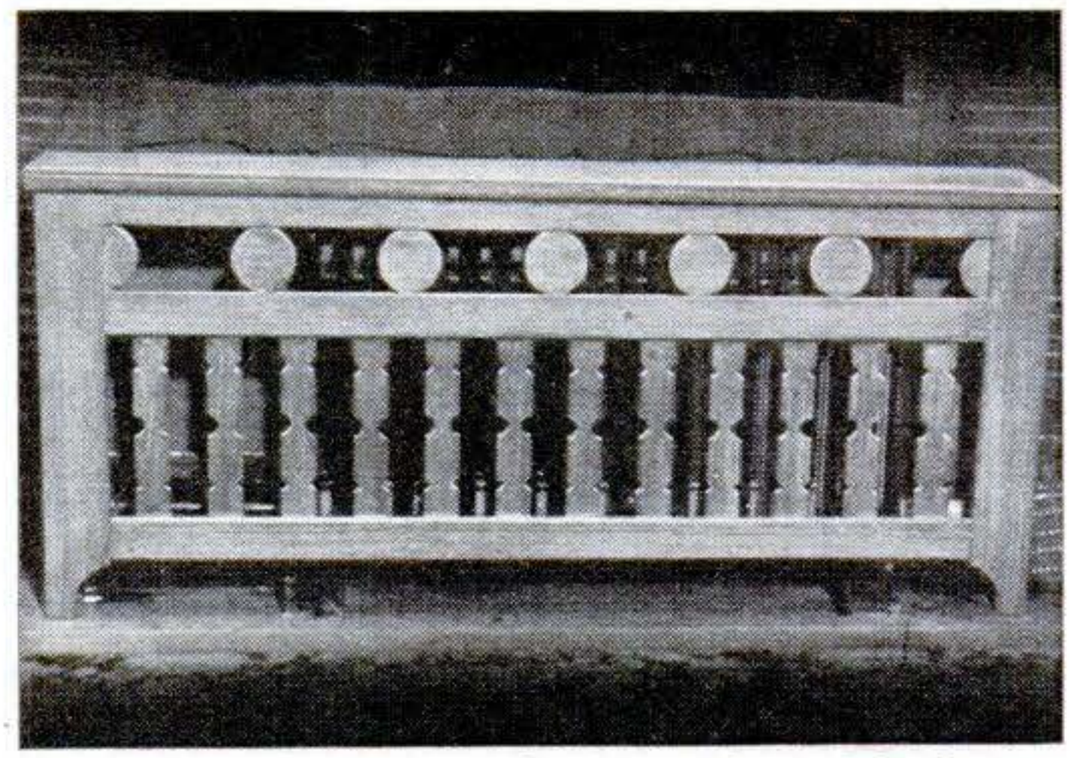
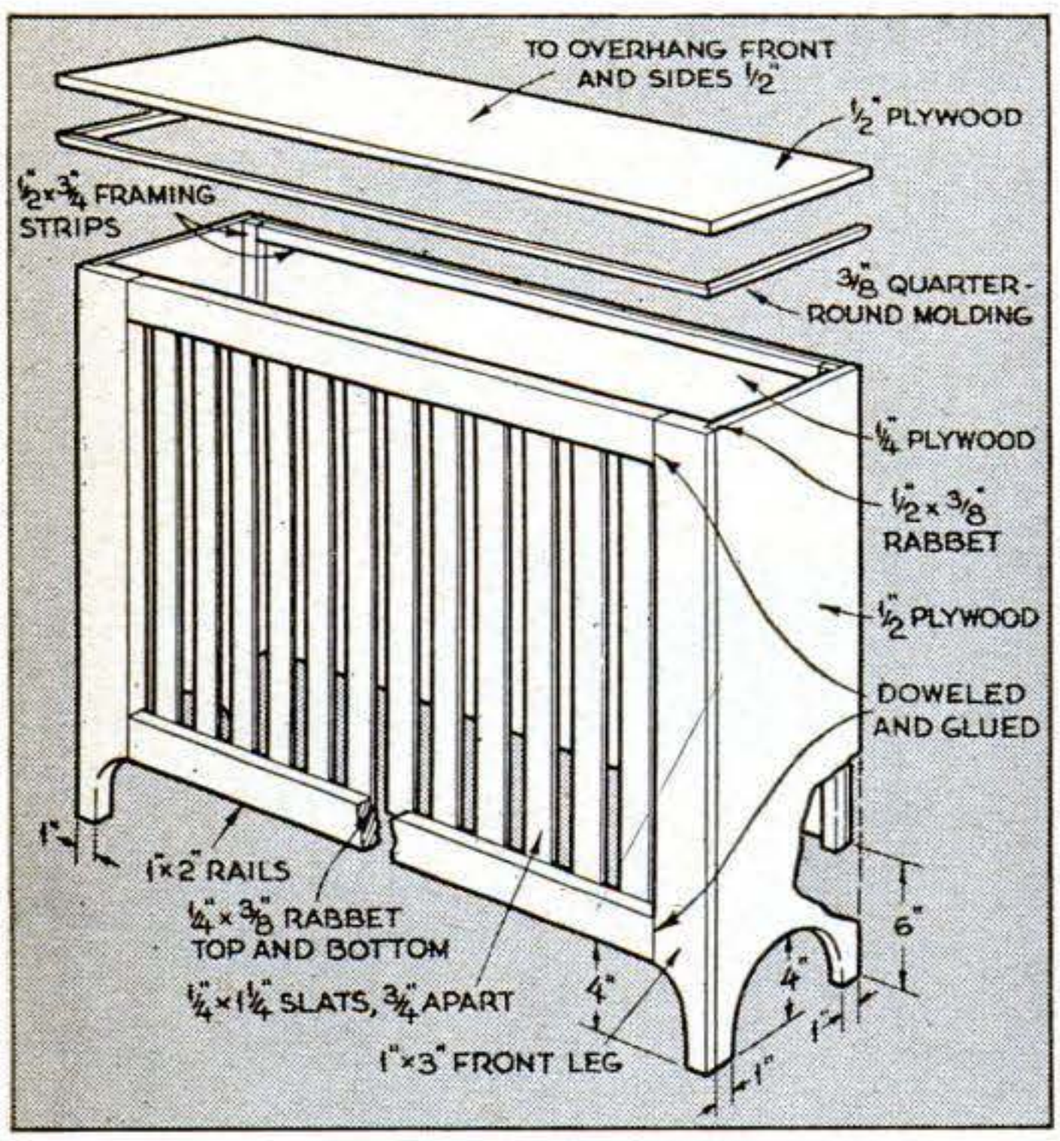


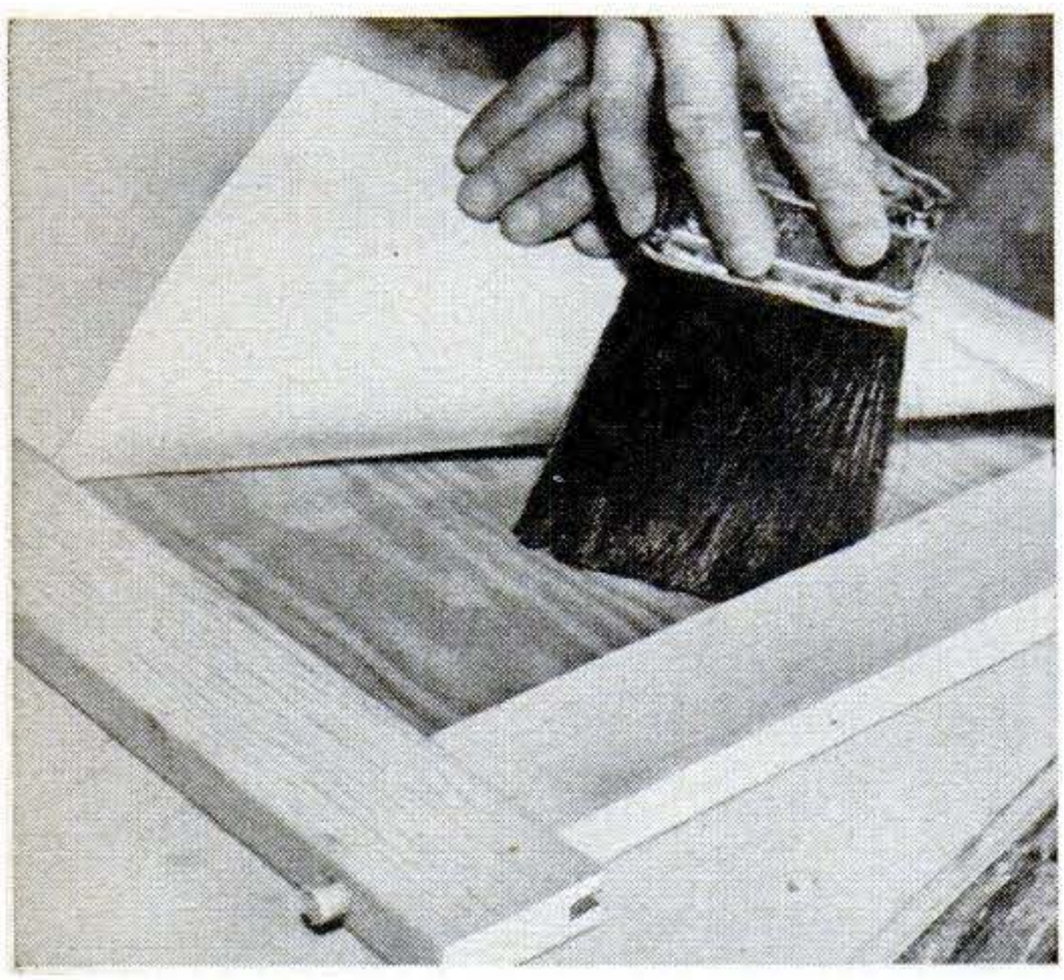
Slat design is good for a bedroom radiator cover. Enamel it white or in colors of room.



Living-room cover is built on plan of bedroom cover with minor variations for decoration.



Here's plan of bedroom cover. Cut out the legs first and join them to rails by glue and dowels.



For insulation you can use asbestos sheeting as above, gluing or tacking it in place, or you can use sheet metal or foil-covered cardboard.

and chest on page 186, make the cover first —assembling the sides, front, and top separately. Join the rails with rabbets and dowels as shown. Glue and nail the turned posts of the grille inside the ⅜" by 1" frame, and then glue the assembly into the front section. Join the sides and front by the four triangular blocks, gluing and screwing them to the vertical rails. Fill the open corners with quarter-round molding.

Since only the outer edges of the top will be seen when the chest is in place, you can save some hardwood here. Rabbet the three 2½" oak border pieces for the plywood center panel. Use wood screws to attach the top to the ¾" by ¾" cleats. Follow the same construction methods in assembling the chest, making it 3" shorter and 1½" narrower than the cover. That will leave a 1½" ledge on the front and sides of the cover. Mortise butt hinges into the rails and edges of the doors.

To position the chest on the cover, glue a dowel in the bottom of each lower corner of the chest. Drill matching holes in the top of the cover. Then set the chest on the cover. The top of the cover will serve as a floor for the chest.

The bedroom and living-room enclosures are built alike, except that a third rail was added to the latter cover, along with wooden disks of 1" stock. The slats of the living-room enclosure were drilled and notched for decoration.

Cut out the front legs first, rabbeting for the plywood sides. All the horizontal rails are 1" by 2" and are rabbeted for the slats, which are glued and tacked in place. In the living-room cover, the disks are glued and doweled between the rails. Allow the tops of these two covers to overhang the front and sides by at least ½". The ⅜" quarter-round is attached beneath. END

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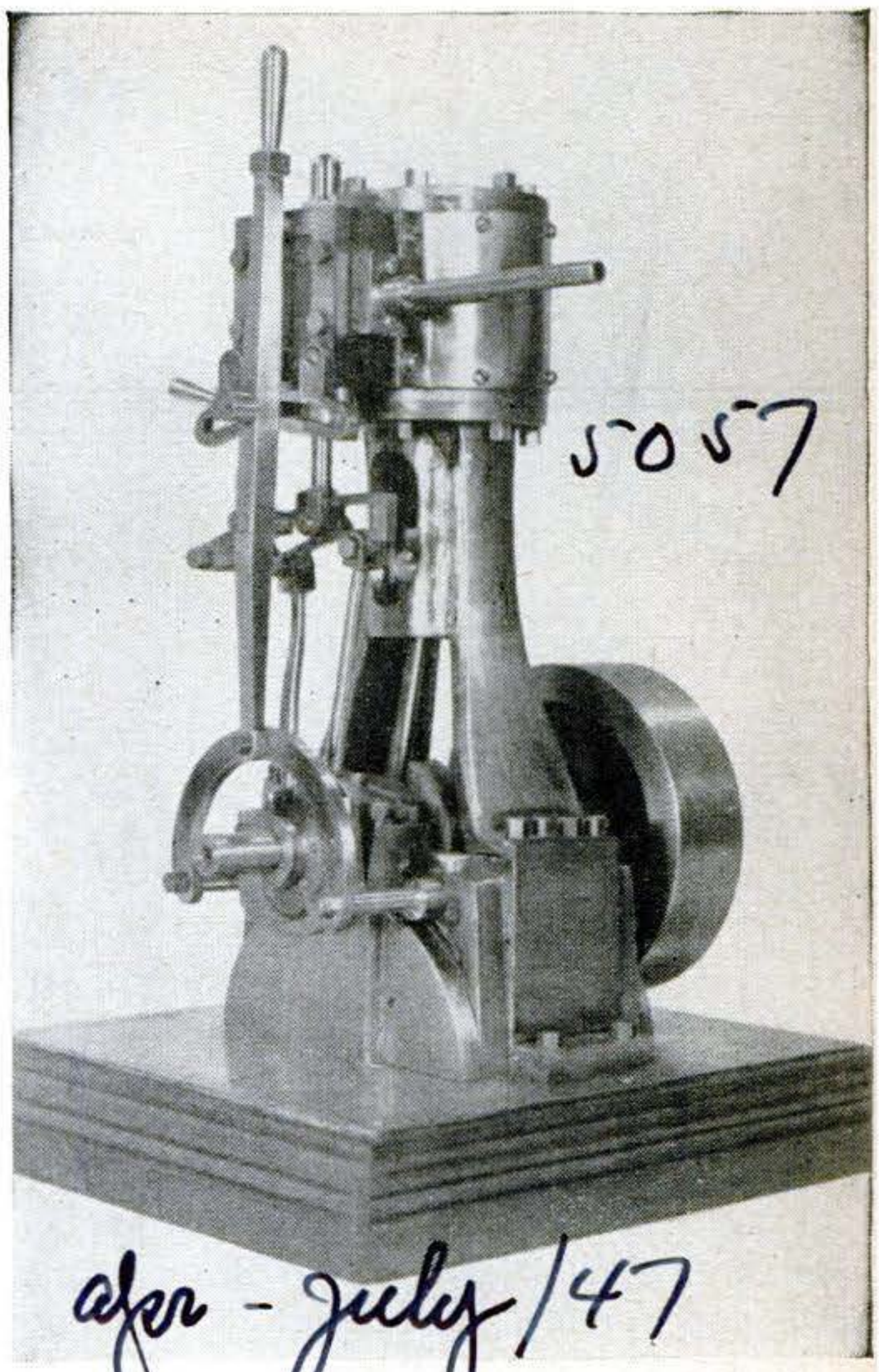
PS Projects Built by Readers

5284

Sept-Oct/46

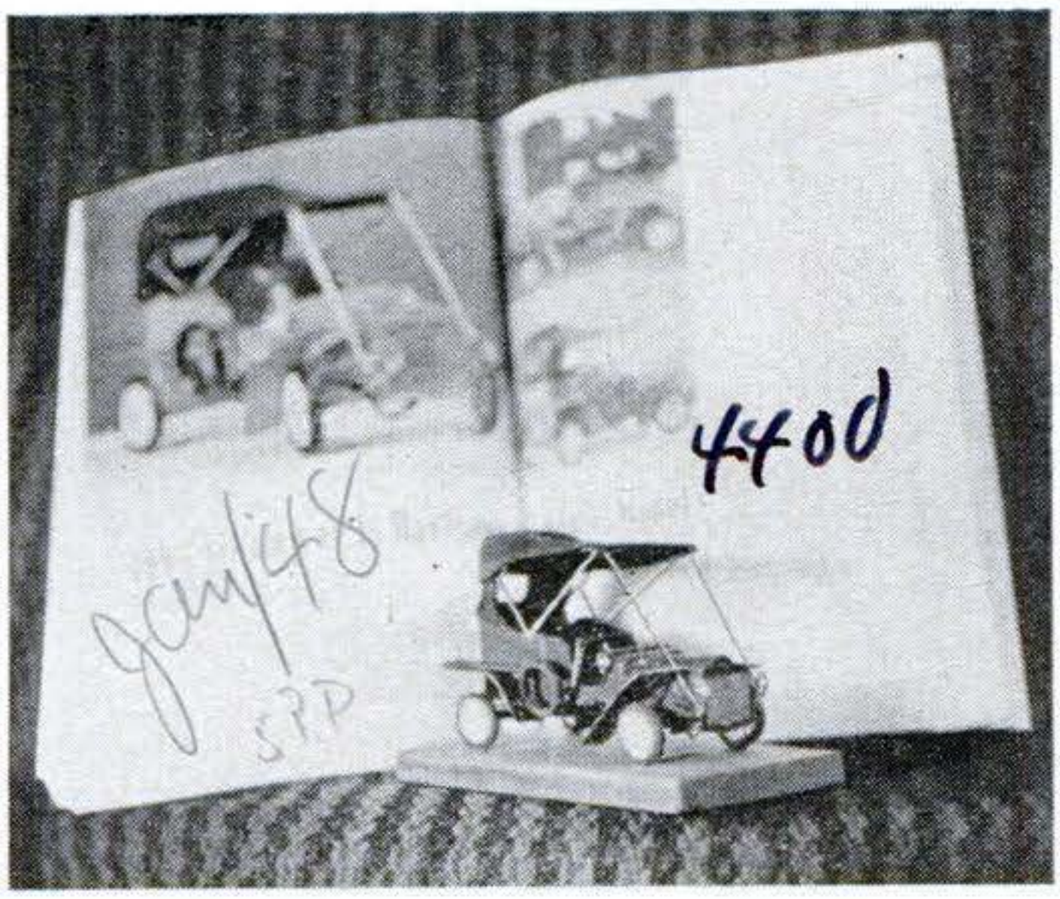
Pioneer Wood-Burner. Memories of diamond-stack engines, seen from his home when a boy, impelled Orrin W. Brusie, of Millerton, N. Y., to build this wooden scale model of the C. P. Huntington. The link hookup was changed slightly from plans in PS so that the reversing links are raised and lowered by a rod running back to the cab. The wheels turn freely, allowing observation of the valve and running-gear action.



5057

Apr - July/47

Steam Engine Reverses. Leon Conley, of Haddonfield, N. J., built this reversing steam engine from plans in POPULAR SCIENCE. The engine is a double-acting non-condensing one that exhausts directly into the air. Conley reports that the working model runs nicely, developing an estimated ⅓ hp. under test.

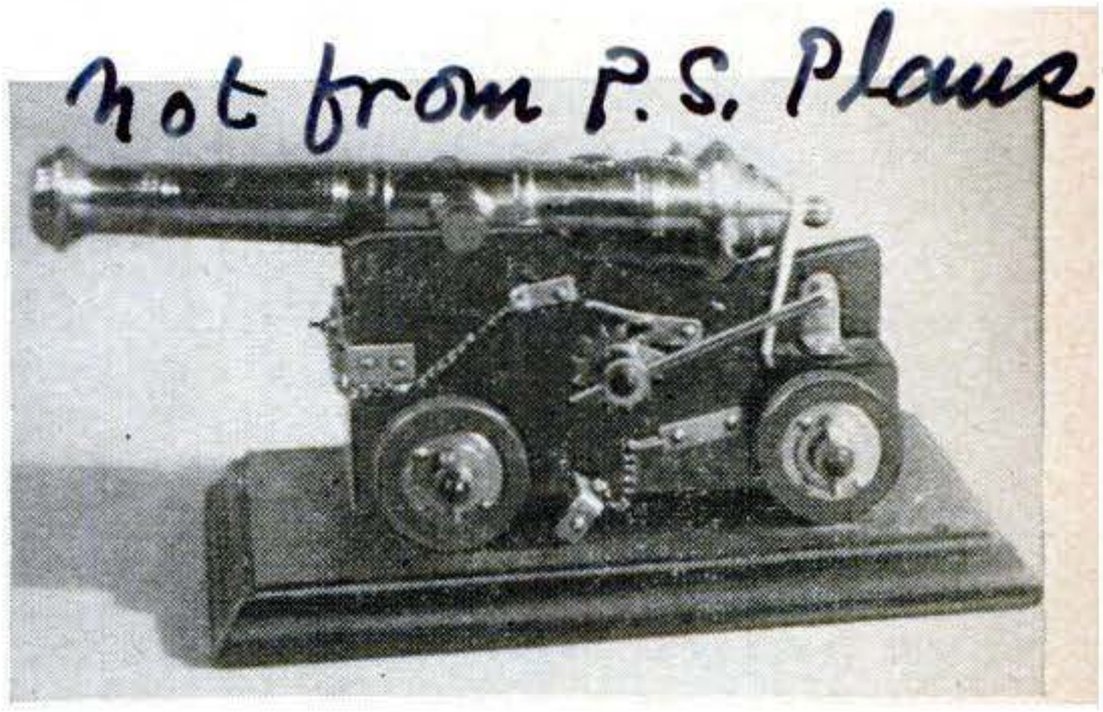


4400

Jan/48

Thumbnail Steamer. It took Irwin F. Kenderdine, Jr., of Reading, Pa., about 50 hours to build this tiny model of a 1905 White steam car. Although the dimensions given in the article were to the scale of ¾″ to the foot, he worked to the reproduction size of the drawings, which gave him a smaller, but still detailed, model.

not from P.S. Plans



Brass Muzzle Loader. This 18th-century naval cannon was built by George H. Crosman, of the Canadian Naval Forces, from plans given in this magazine. More than four months of spare time was put into the project. Instead of using oak for the carriage, he worked with mahogany. All metal parts are made of brass.

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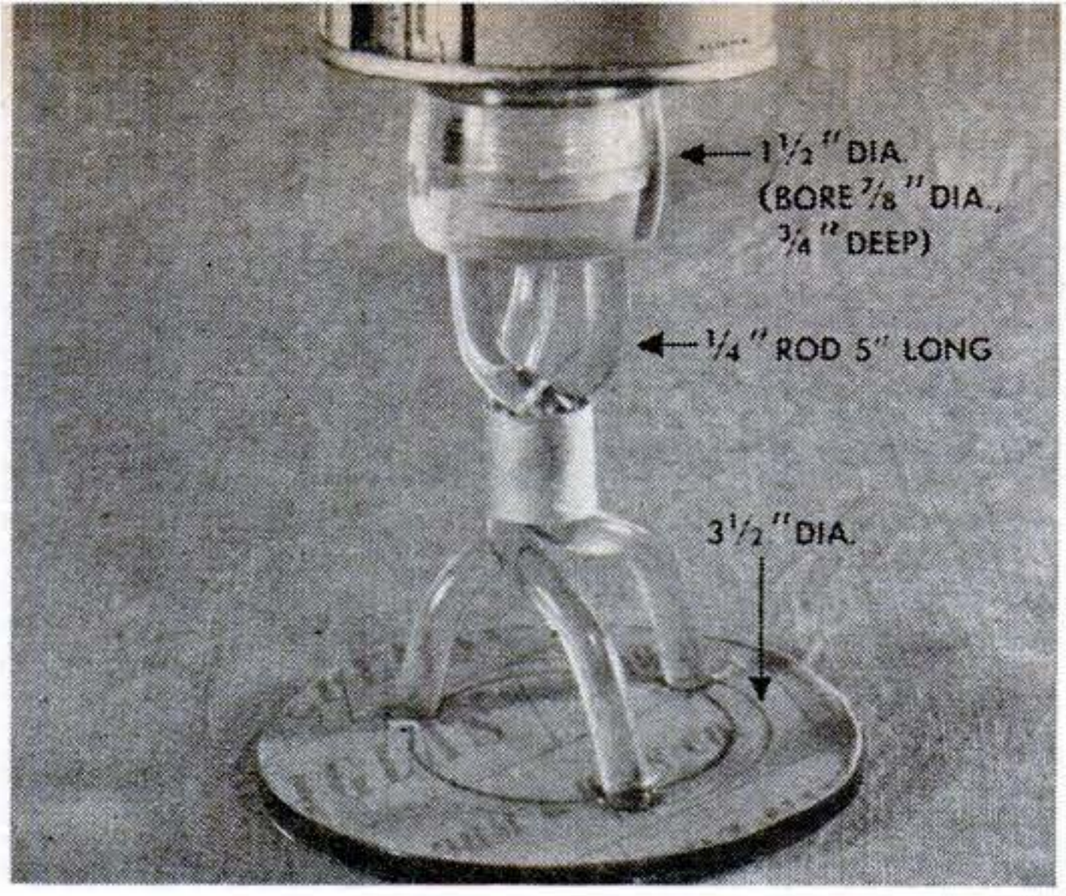
Highly polished, these candleholders gleam and sparkle like crystal. They're made of plastic.



Bind the spiral tightly with tape. Leave this on until the top and bottom joints have set.

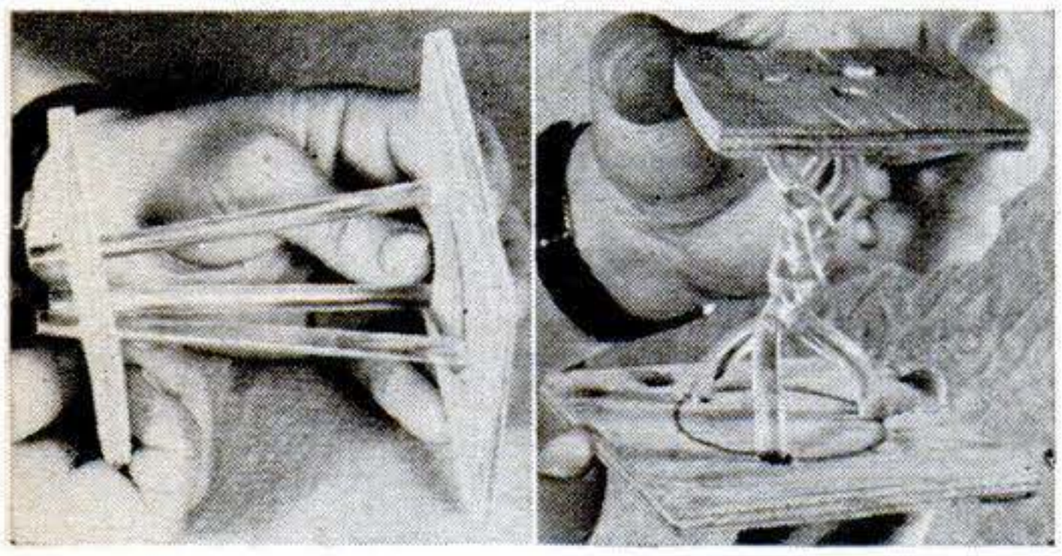
5479

Candlesticks with a Twist

HERE'S an intriguing project for the craftsman who enjoys putting plastic through its paces. Columns are formed for these candlesticks by twisting three ¼" rods into a spiral at the center.

This is accomplished with a simple jig. Lay out a 2" circle on a scrap of wood, divide the circumference into three equal parts, and at each point bore a ¼" hole on a slight inward slant. Repeat with a 1" circle on a second piece of wood.

Now fit three 5" lengths of ¼" rod into the jig, put the entire assembly into an oven, and heat to 250 deg. Remove the assembly and twist the two wood pieces until you've made three full turns. Hold the wooden pieces parallel and let cool.



Form the spiral with this jig. Heat the whole assembly to 250 deg. and twist the jig three full turns. Saw off the projecting rod ends as necessary to make the holder stand level.

For the candle cup, chuck a length of 1½" plastic rod in the lathe, true up the end, and turn out a ⅞" recess ¾" deep. Polish with sandpaper wrapped around a dowel. Turn the outside as desired and cut to an overall length of 1⅛". Saw the 3½" base disk from ⅛" or ¼" sheet.

This done, tape the spiral column tightly, remove the lower jig member, and set the feet on the base. Mark their location and peel the masking paper from these spots. Put the ends of the legs into plastic solvent until slightly spongy. Then set them in place on the base and put a light weight on the top.

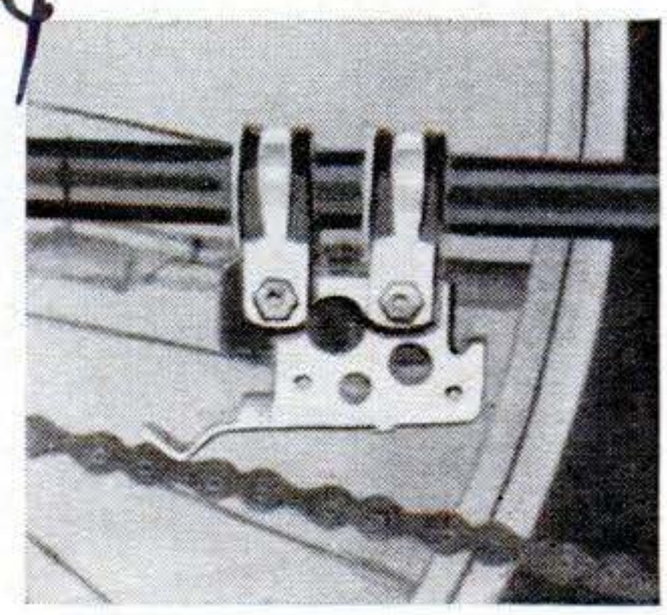
For a strong, invisible joint, leave the weight in place about 24 hours. Join the other ends of the ¼" rods to the candle cup in the same way, this time resting a weight atop the cup.

After buffing and polishing, protect the candlesticks by applying a coat of wax.—*Elma Waltner, Hurley, S.D.*

Snap Switch Operates Bike Stop Light

5354

STARTING with a Microswitch Ⓣ, I've installed a stop light on my son's bike that beats anything else I've seen. The switch is the overtravel type with a springy contact arm. I clamped the switch to the horizontal fork member just above the slack lower half of the chain and wired it in series with the light circuit. As soon as the brake is applied, the lower part of the chain becomes taut, pressing up the switch arm and closing the circuit.—*Freeman Smith, N. Hollywood, Calif.*



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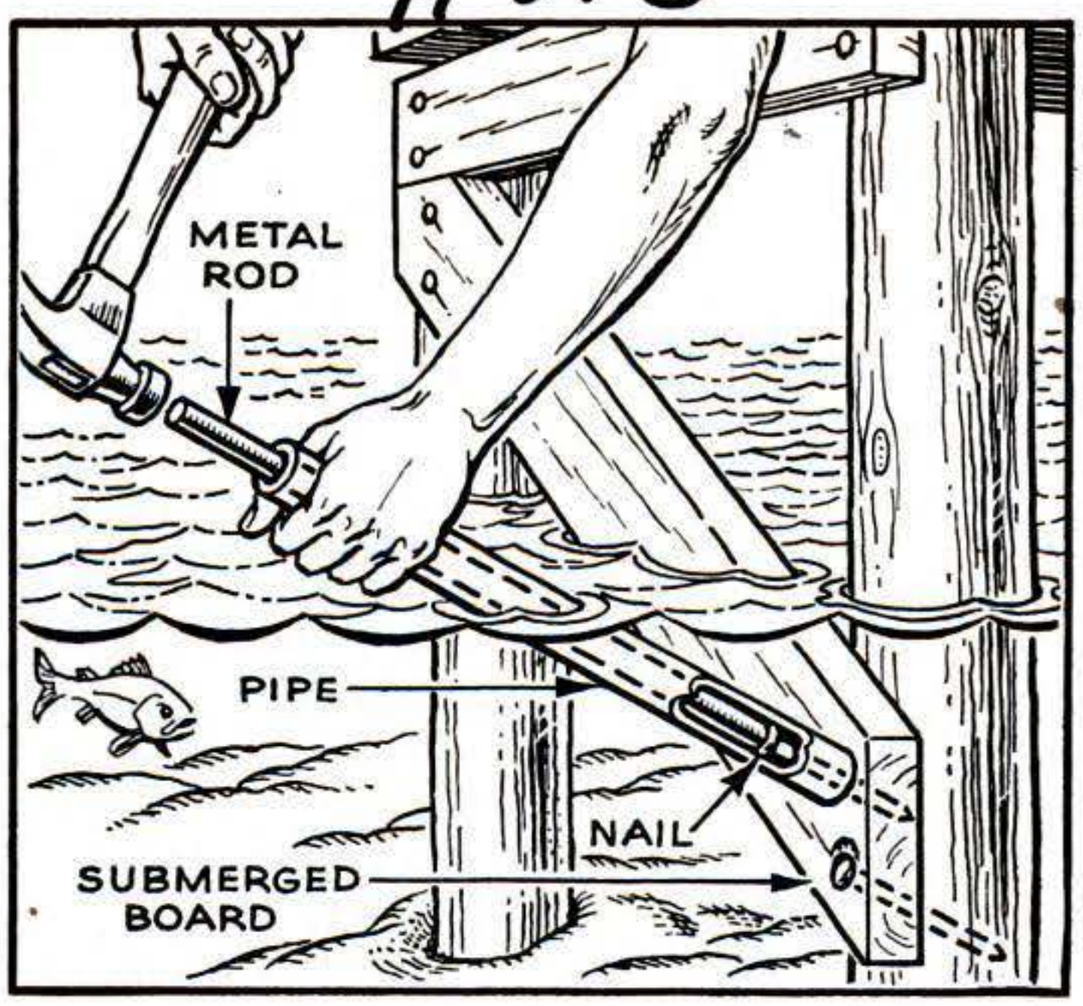


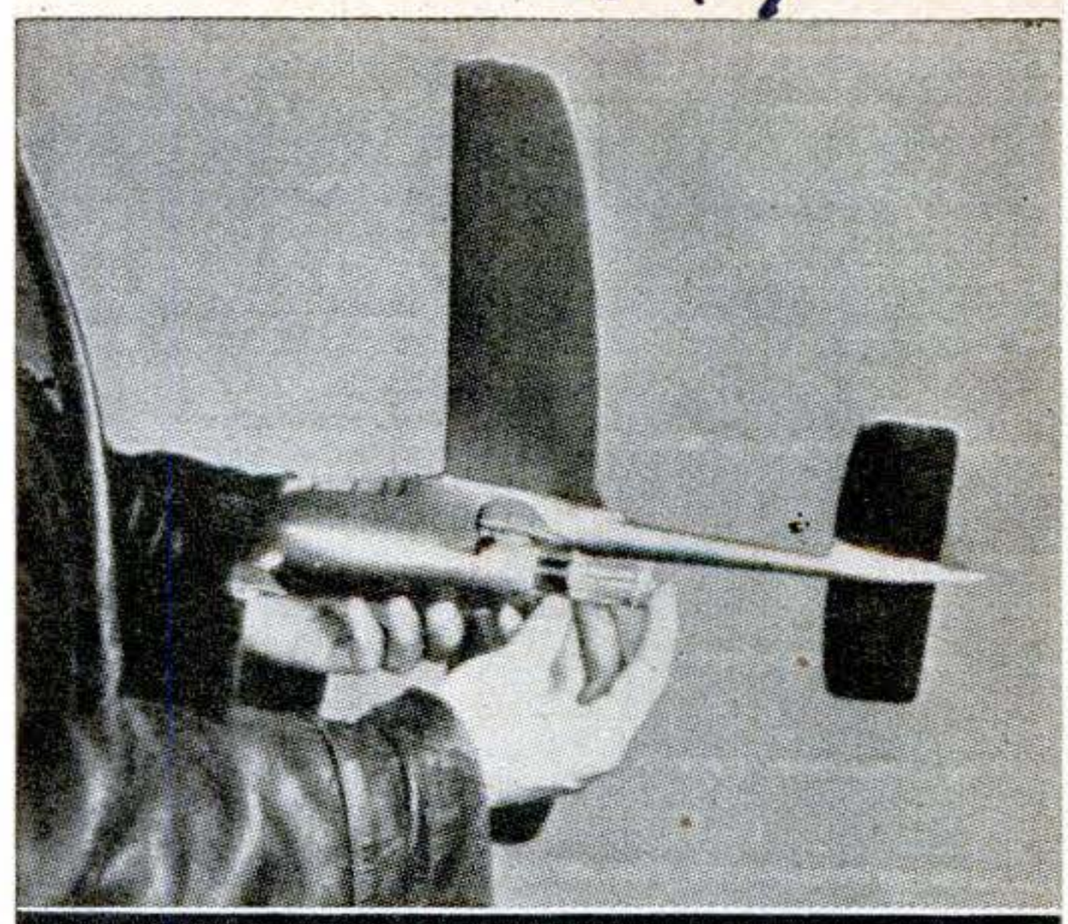
Hammering Nails Under Water

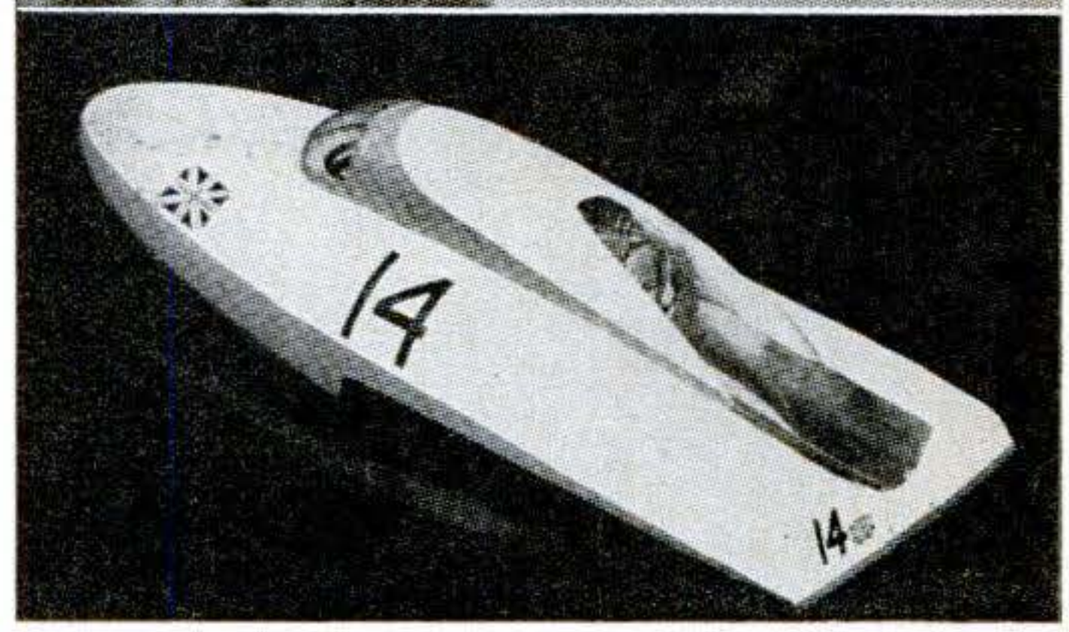
A LENGTH of small-diameter pipe and a metal rod will drive nails in submerged boards without splashing. Place the pipe on the spot where you want the nail, drop the nail through the pipe, and insert the rod after it. Hammer the rod to drive the nail home.—*A. Armstrong, Missoula, Mont.*

Gadgety Box Amuses Children

MY YOUNG son's fondness for snapping the radio off and on and twisting the dials was satisfied with this safe electrical toy. Built of scrap radio and electrical parts, it features a snap switch that lights a large, jewel-type pilot light; a radio key that rings a doorbell; and other knobs and dials that just turn around or that give a solid click, such as an aircraft magneto switch. Power can be dry cells or a doorbell transformer. —*E. P. Bonner, Falls Church, Va.*

5492

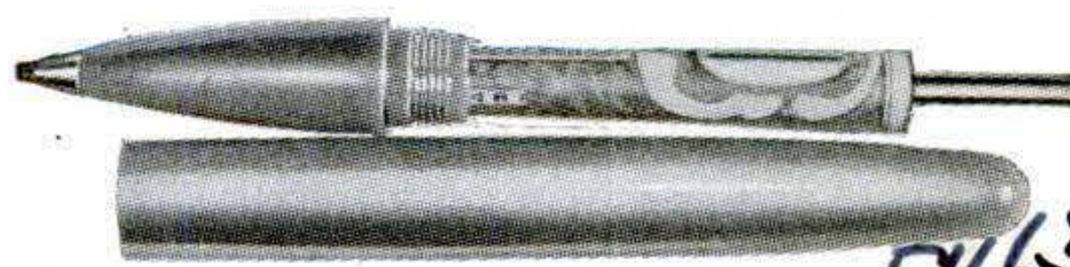




Toy Jet Engines Drive Models

JET cartridges, burning a modified form of cordite to propel model planes, cars, and boats, have been announced by Imperial Chemical Industries, a British explosives manufacturer. The cartridges are made in various sizes from a tiny unit giving ⅛-oz. thrust to a 2″ long by 1″ diameter unit producing 1¼-oz. thrust.

A typical cartridge is a cardboard tube 1⅞″ long and ⅞″ in diameter. It is closed at one end and has a thin metal disk at the other. In the center of the disk is a tiny vent, the jet. The driving charge, ignited by a match or burning cigarette, burns from 10 seconds to several minutes.



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Ball-Point Pen Hides Money

MOST ball pens have plenty of room in the barrel around the thin ink-supply tube to hide a large-denomination bill or a valuable paper. Wrap the paper tightly around the tube and push it well down in the pen-tip recess as shown above. Then replace the barrel.—*Jack Wilson, San Pedro, Calif.*

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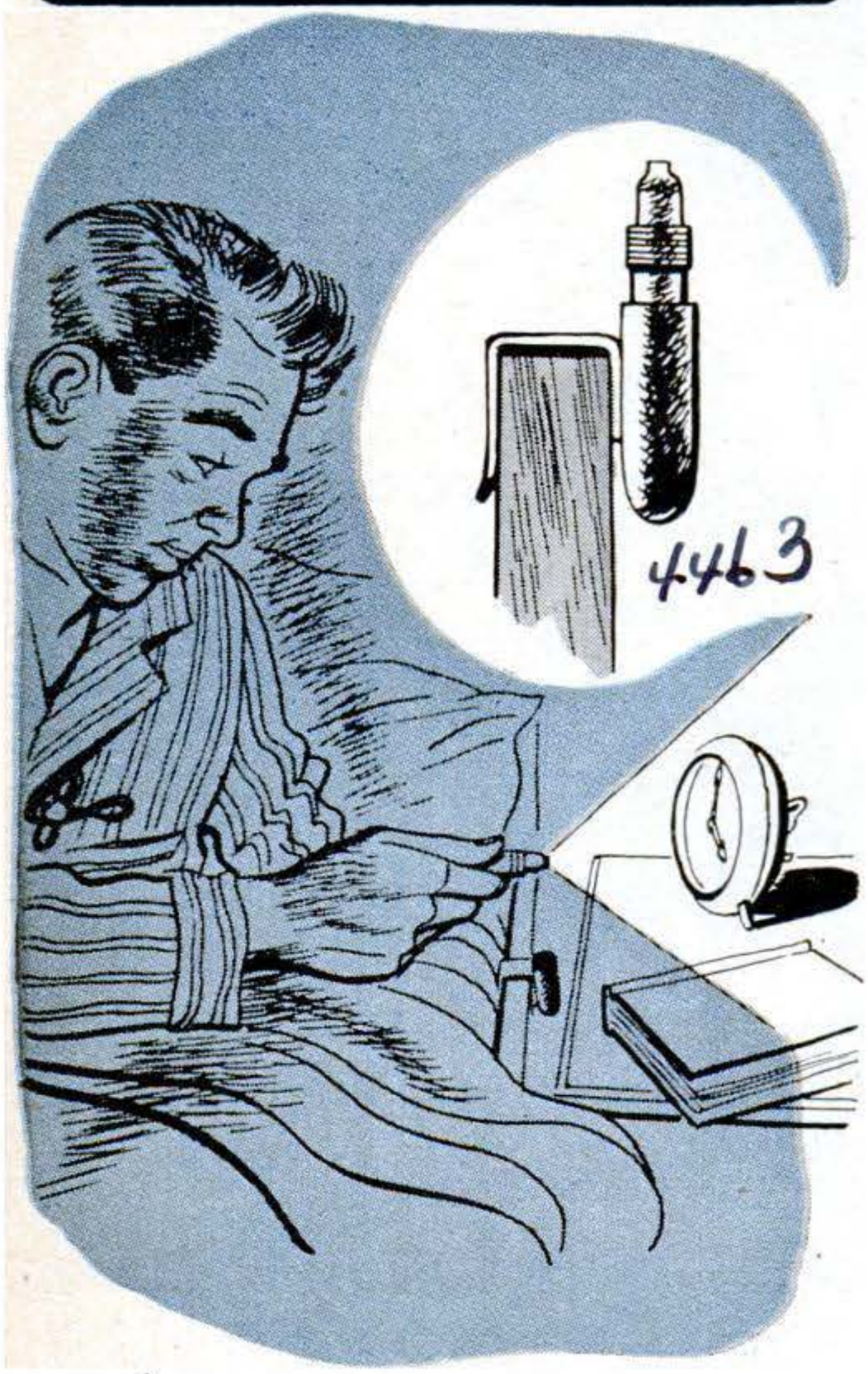
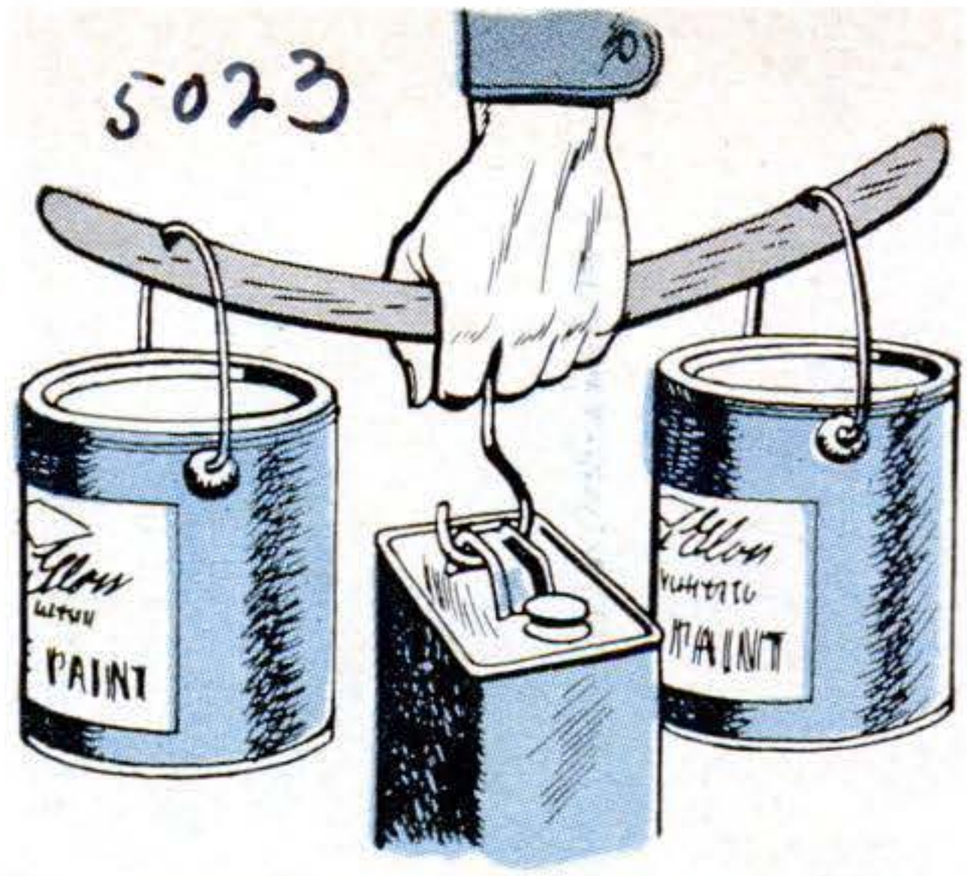
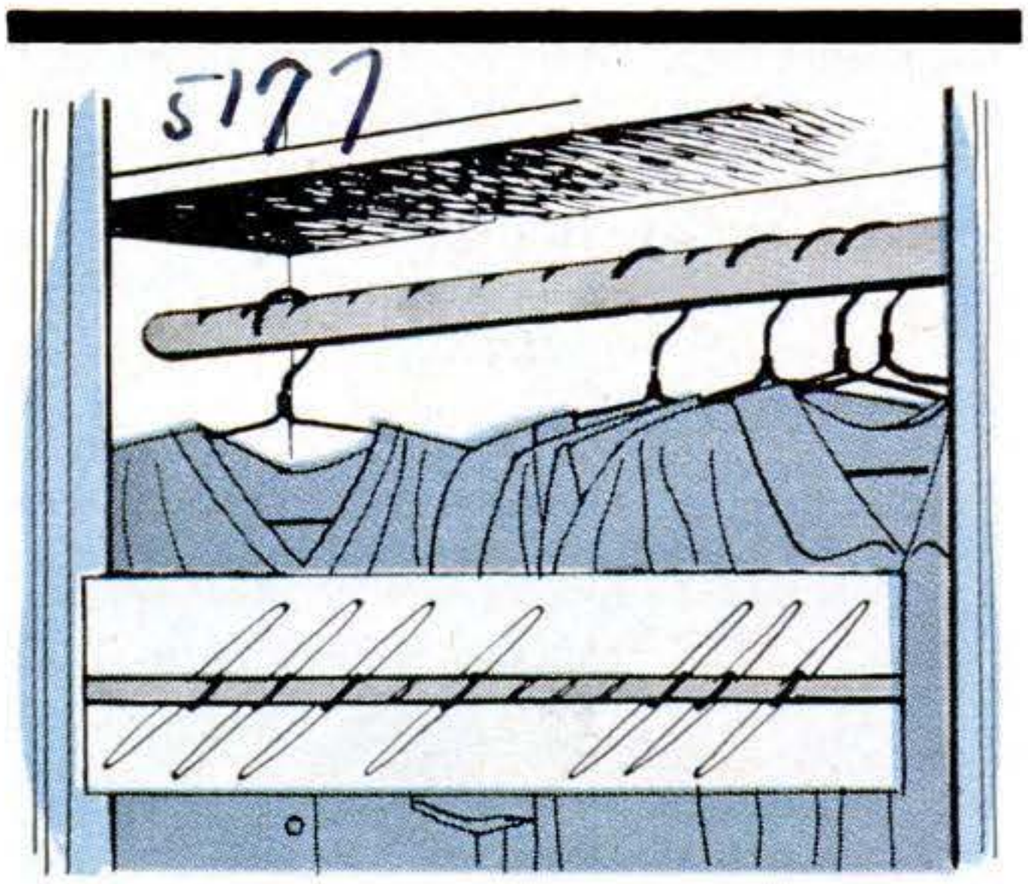
Keeping the Home Shipshape



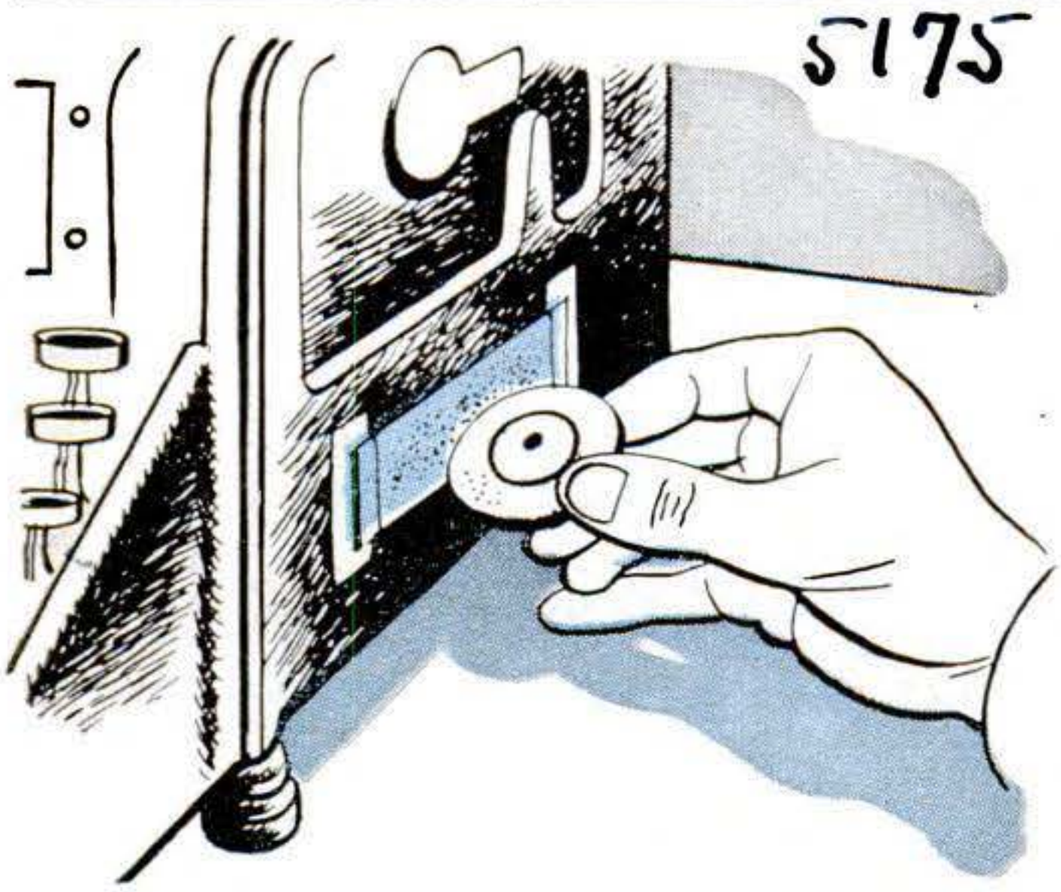
A small penlight by the bed may come in handy if you want light without disturbing other sleepers. A lipstick container soldered to a metal strip will clamp it on the bed rail.



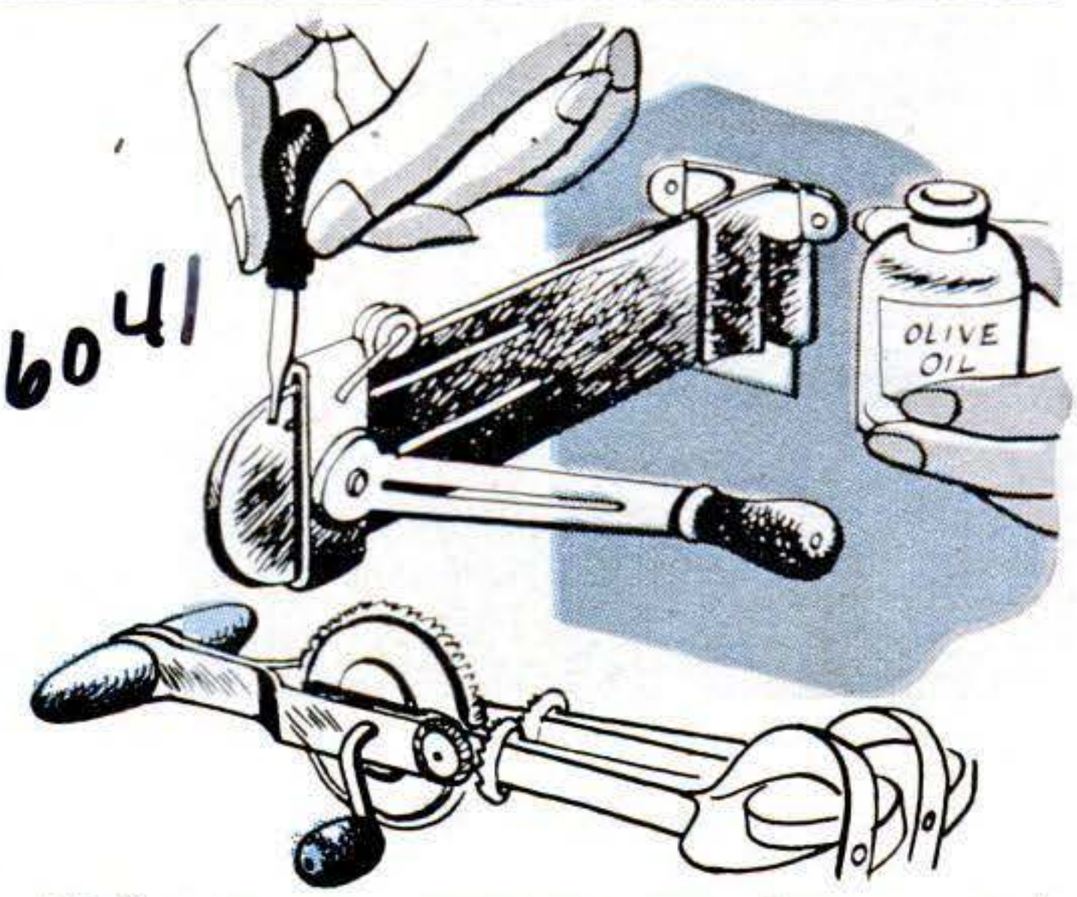
For convenience in carrying cans of thinner, paint, varnish, and the like to a job, use a notched wooden clothes hanger as shown. It's a cinch to carry two or three cans in one hand.



Cut diagonal grooves in the clothes pole of a shallow closet. This will turn the hangers at an angle and prevent the clothing from being crushed between the wall and closet door.



Only a clean eraser can make a clean erasure. You'll always be able to get a clean edge on your typewriter eraser if you tape a strip of manicurist's emery board to the machine.



Wall-type can openers, egg beaters, and similar appliances need lubrication. If you're reluctant to use machine oil on them, try olive or cooking oil as a substitute lubricant.

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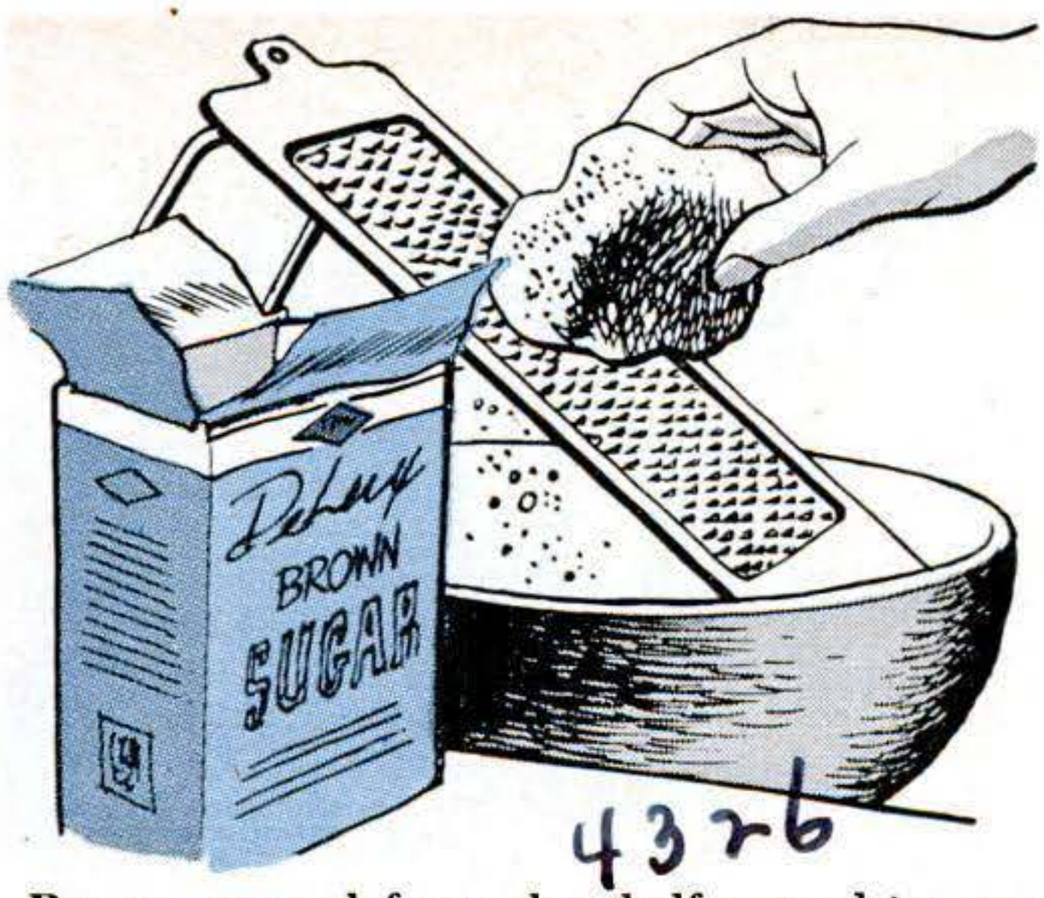
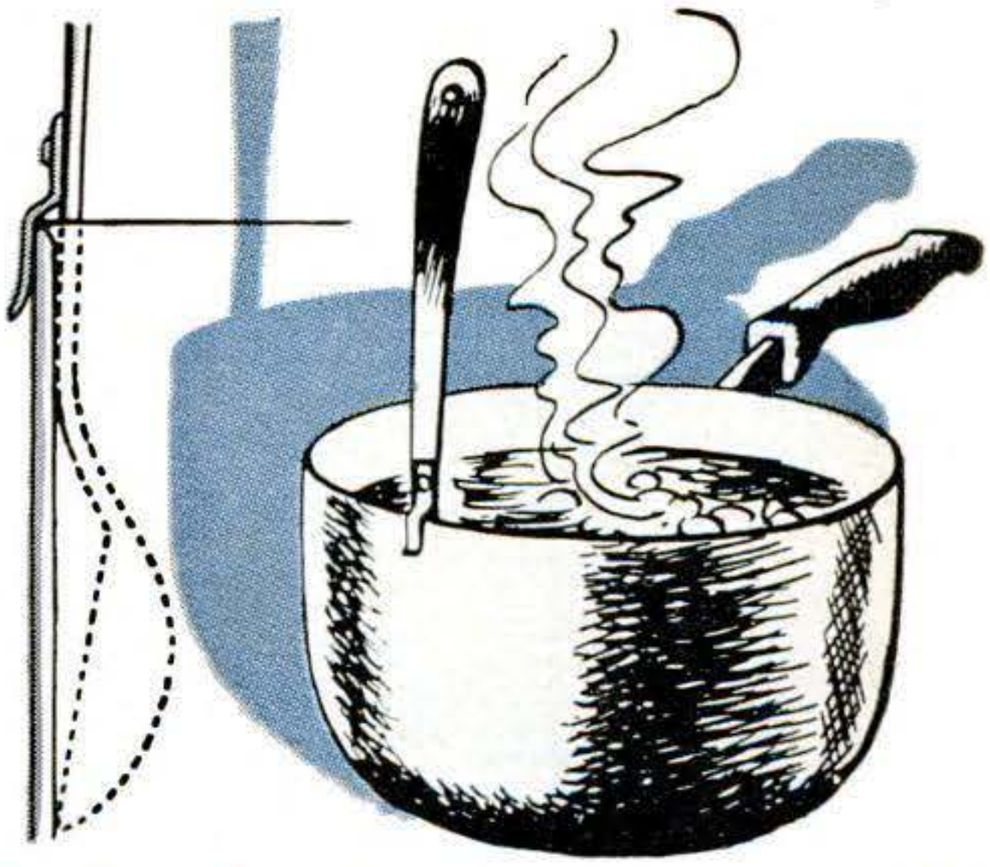
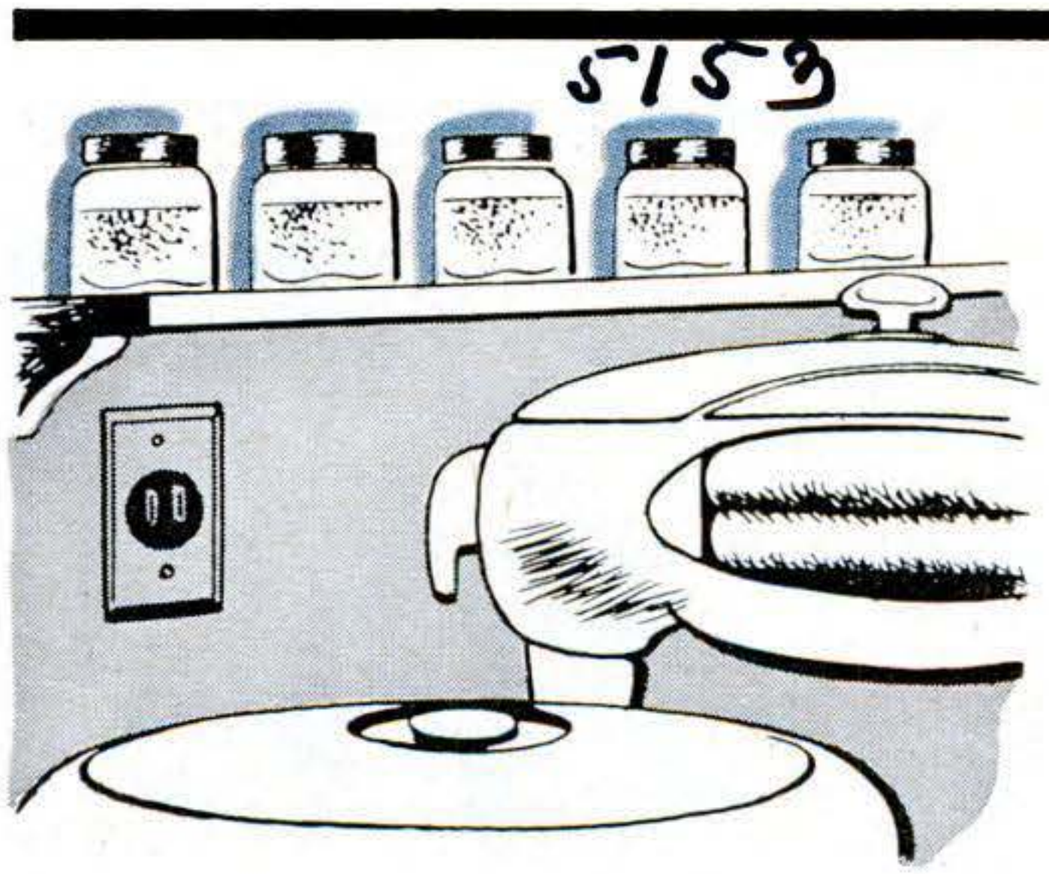


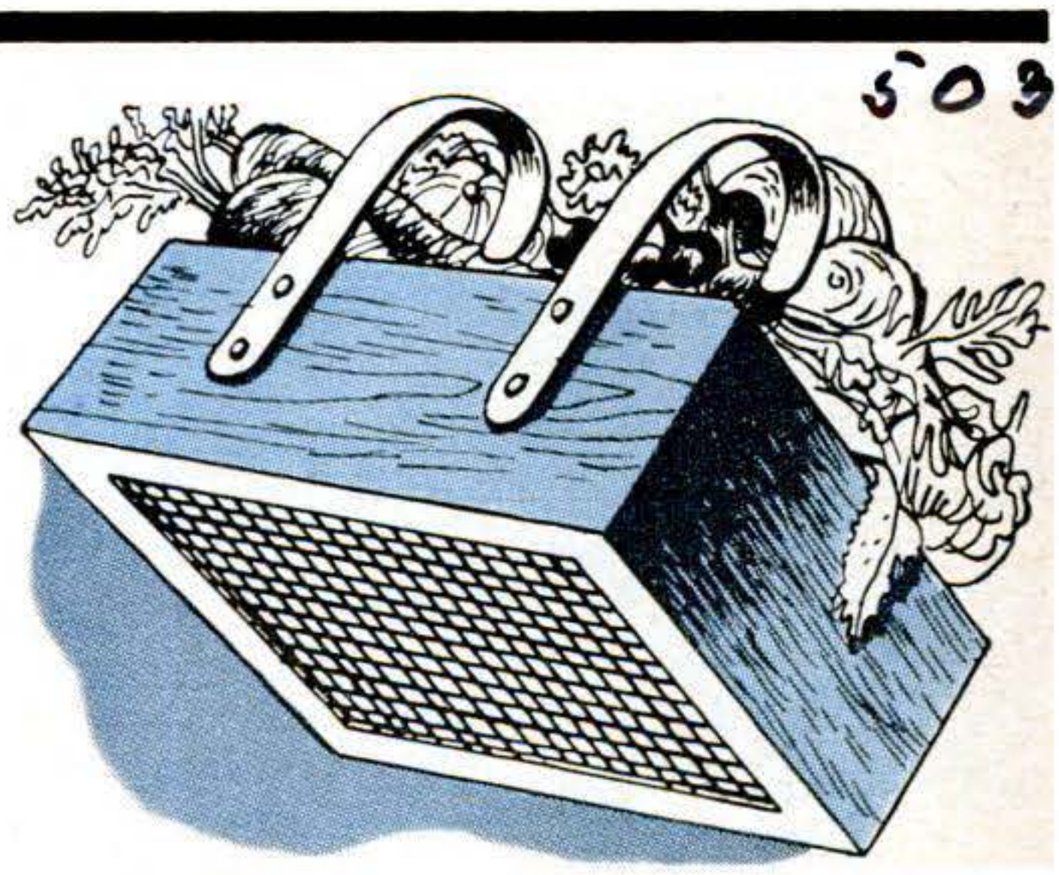
Brown sugar left on the shelf soon dries out and hardens into a solid chunk. To break it up, remove the lump from the box and rub it back and forth on a kitchen grater.



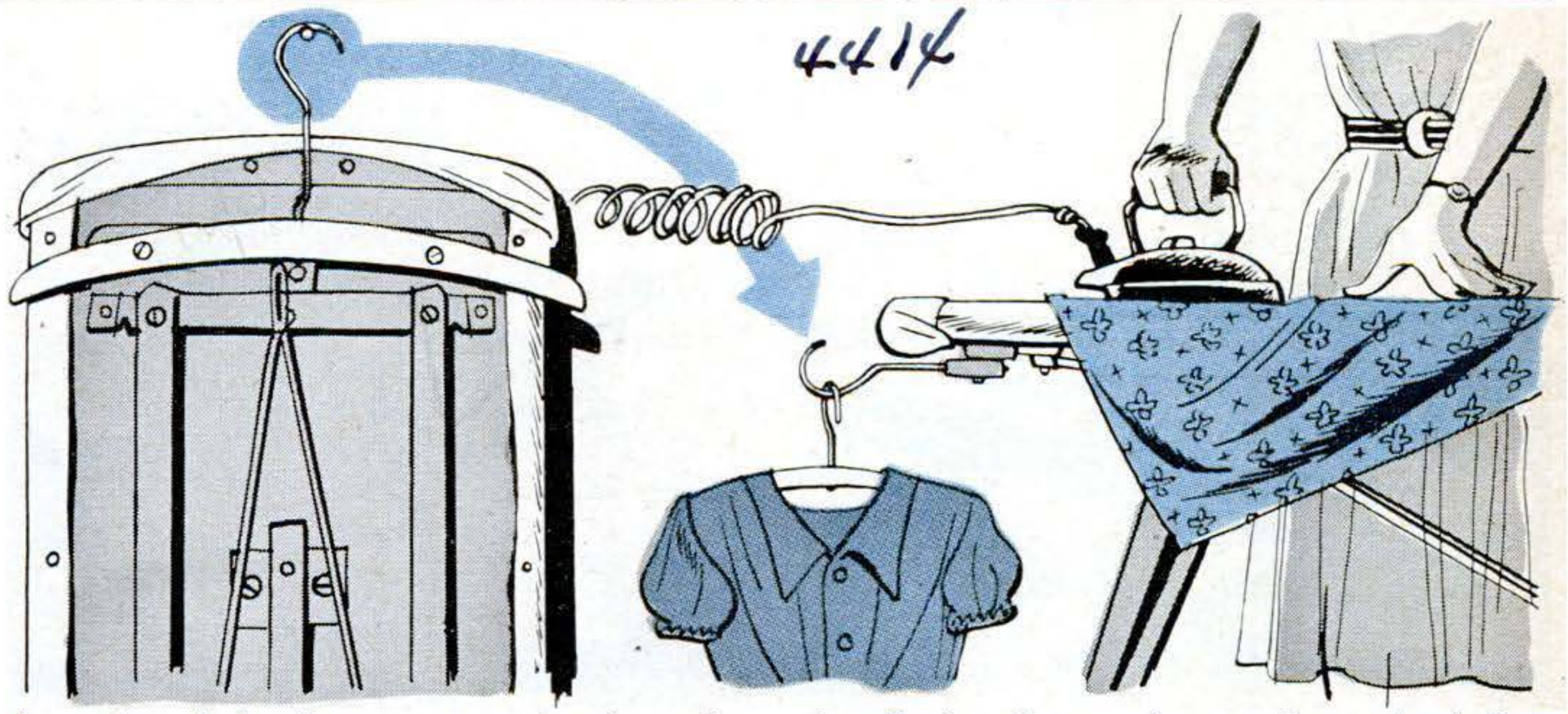
Fitted with a clip, a stirring spoon can be attached to the side of the pan while not in use. Form the clip from aluminum, brass, or stainless steel. Rivet it to the handle.



Instead of measuring out soap, bleach, bluing, or softener every time you wash clothes, put up the proper mixtures in glass jars. You can make enough to last for a few weeks.



Vegetables gathered from the garden in this basket can also be washed in it. Make a wood box small enough to fit in the sink and use a piece of hardware cloth as the bottom.



A wooden clothes hanger screwed to the underside of an ironing board serves both for hanging the board in a closet and as a hook from which you can suspend freshly pressed clothes.

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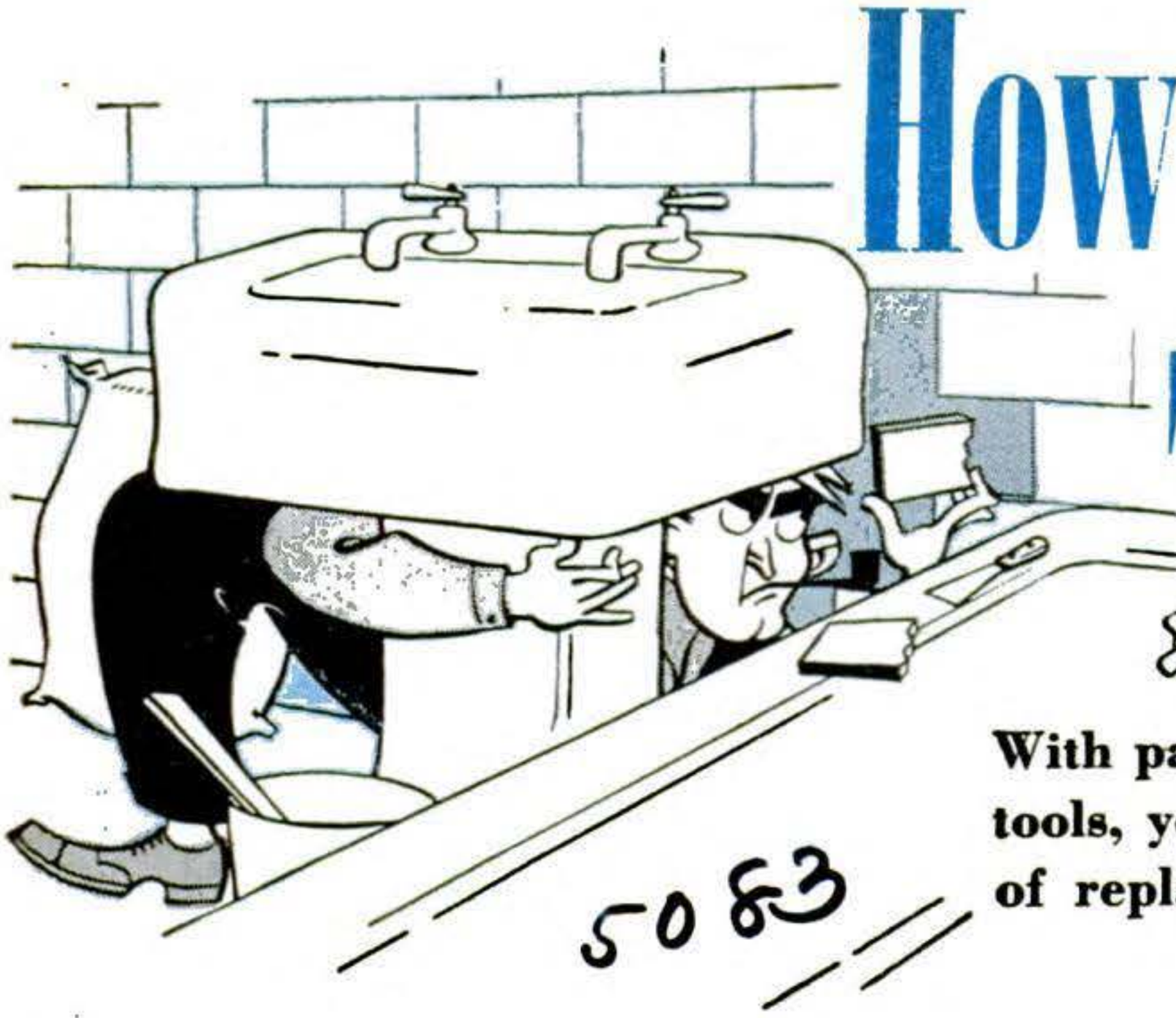
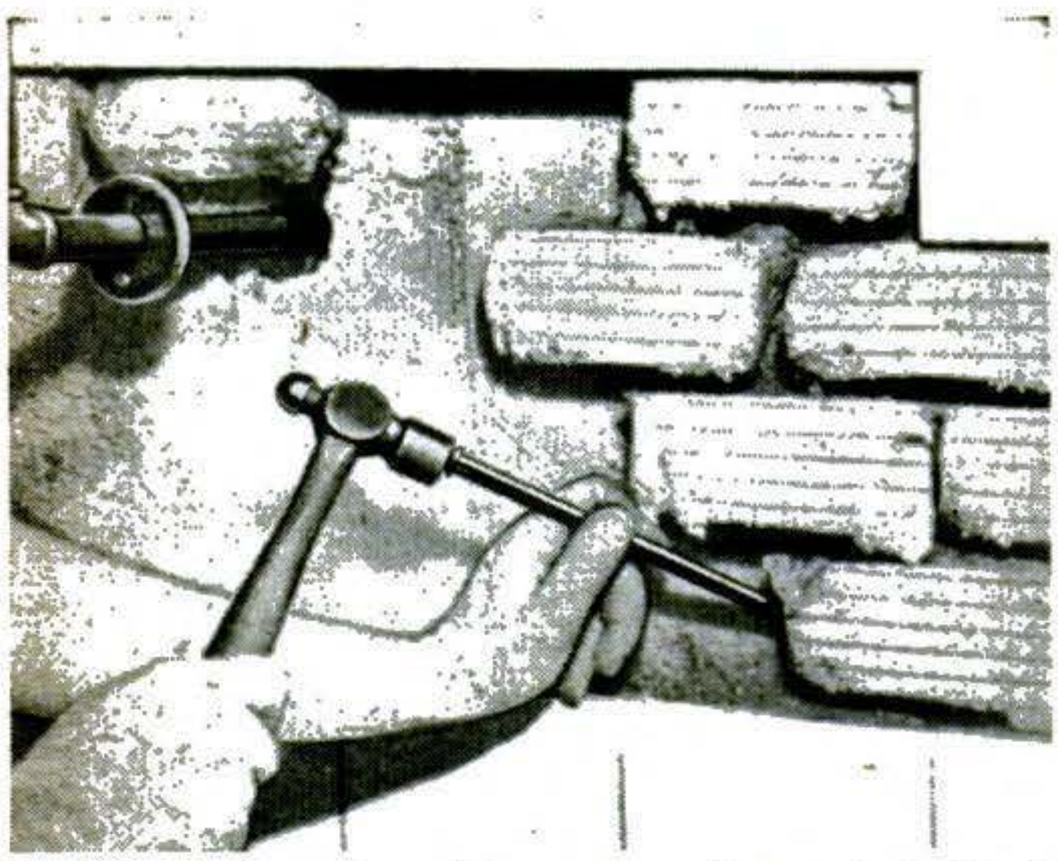


How to Repair Tile Walls

With patience, know-how, and simple tools, you can do a workmanlike job of replacing loose or damaged tiles.

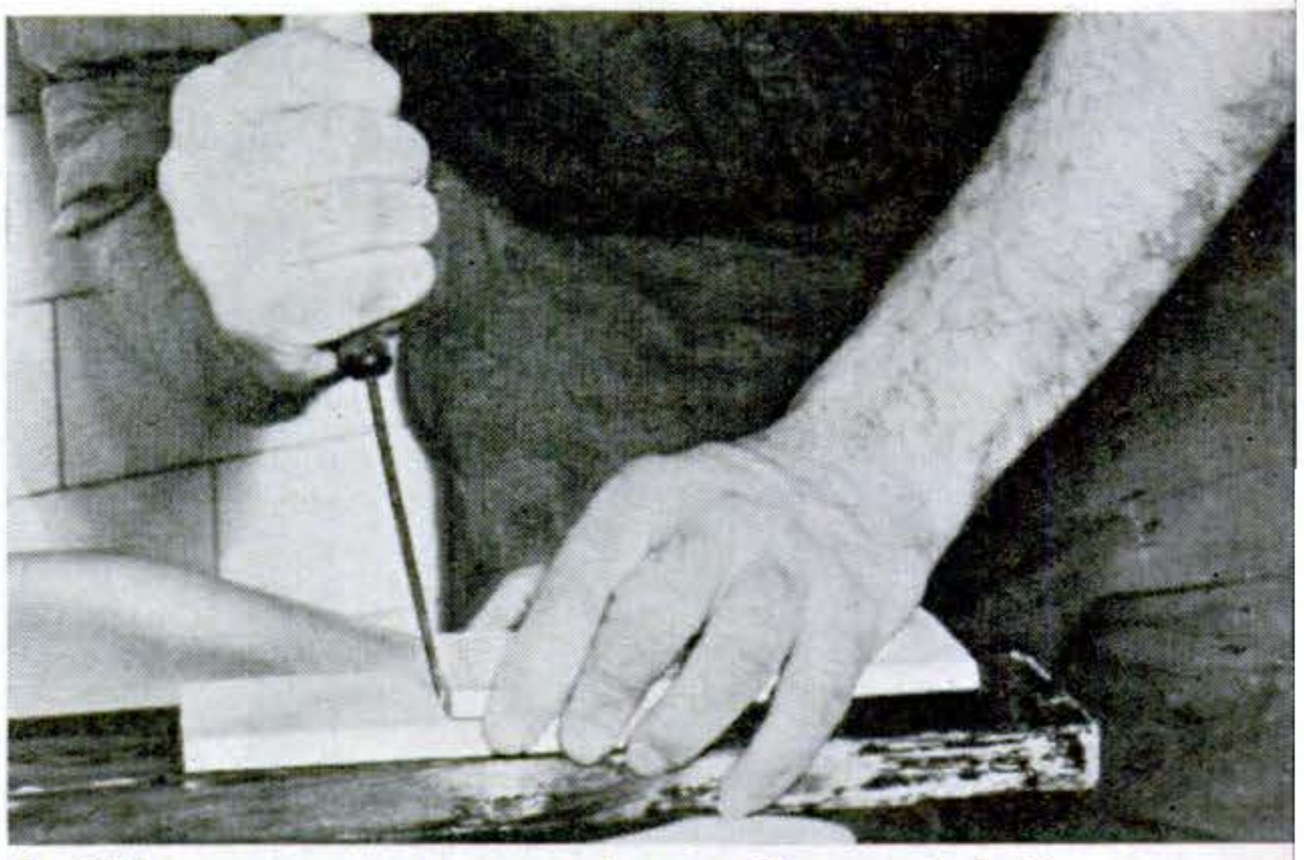
By Joseph J. Moro-Lin



1. Removing the old mortar. A pointed chisel is inserted between the slabs and the scratch coating. Chisel is tapped lightly, slab pried out.

2. Tile is cleaned thoroughly, especially on edges where cement grouting has adhered. Flat tool, such as a narrow putty knife, is handy.

5. Voids are filled in and excess mortar removed after each row of tiles has been set in place. Fresh-laid row is steadied with board.



6. When necessary to trim a tile, scratch it with a sharp-pointed tool, such as an ice pick. Another tile can be used as a straightedge.

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THREE things are important when you tackle a tile repair job: cleanliness, mortar of the right thickness, and patience. You can't rush the work, especially if it's your first attempt.

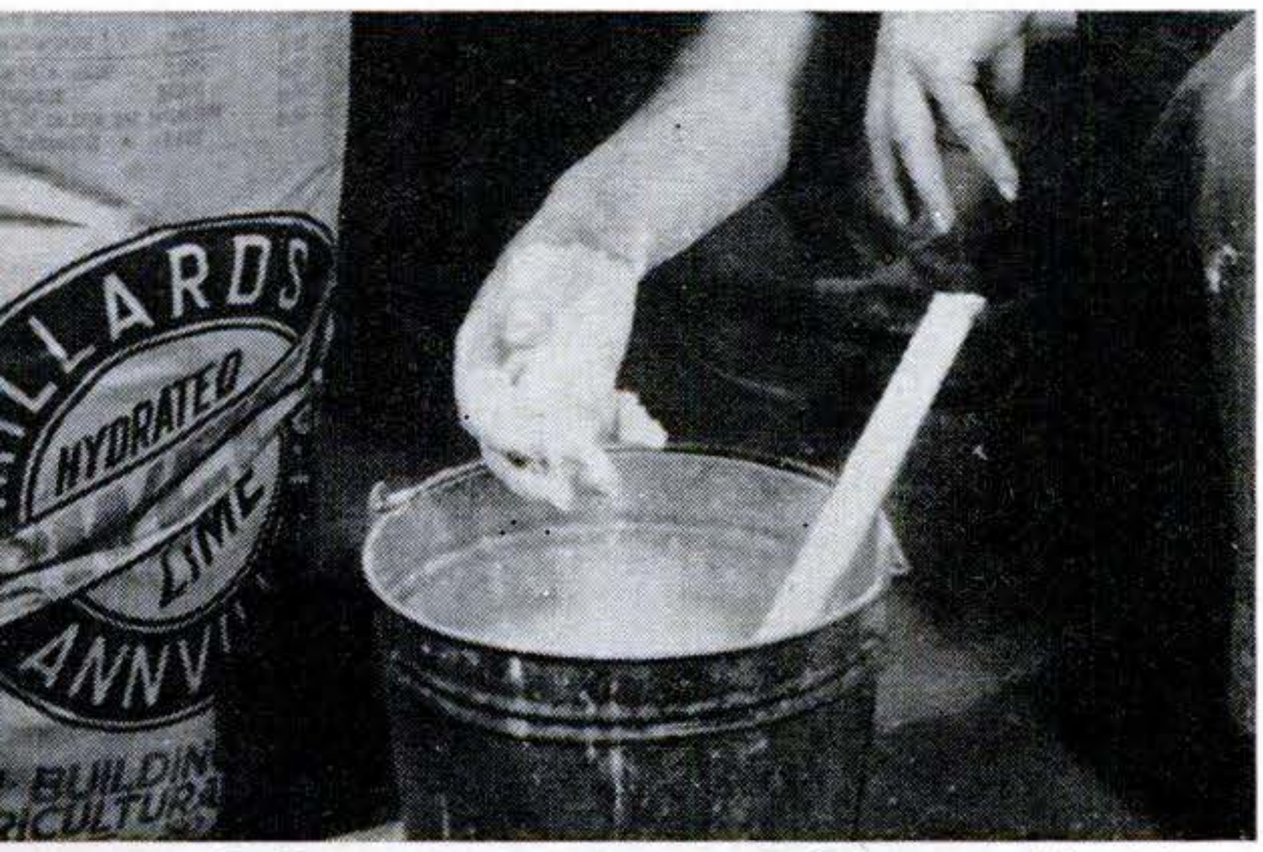
Tiles may be loosened by settling of a building, or perhaps a wall must be opened to repair plumbing. In either case, save the pieces removed from the wall. If you have to buy replacement tiles, match them for color and size. Take a sample to a dealer. Usually he'll be able to tell you who manufactured it.

To go into a wall for plumbing repairs, you'll have to break the first tile. Use a sharp-pointed chisel at the corners of the tile. In most cases the corners are free of mortar backing. Place the chisel on a corner and with light hammer blows—to avoid damaging adjacent tiles—crush in the corner. Continue chipping gently until you reach the edge of the backing. Do this at all four corners.

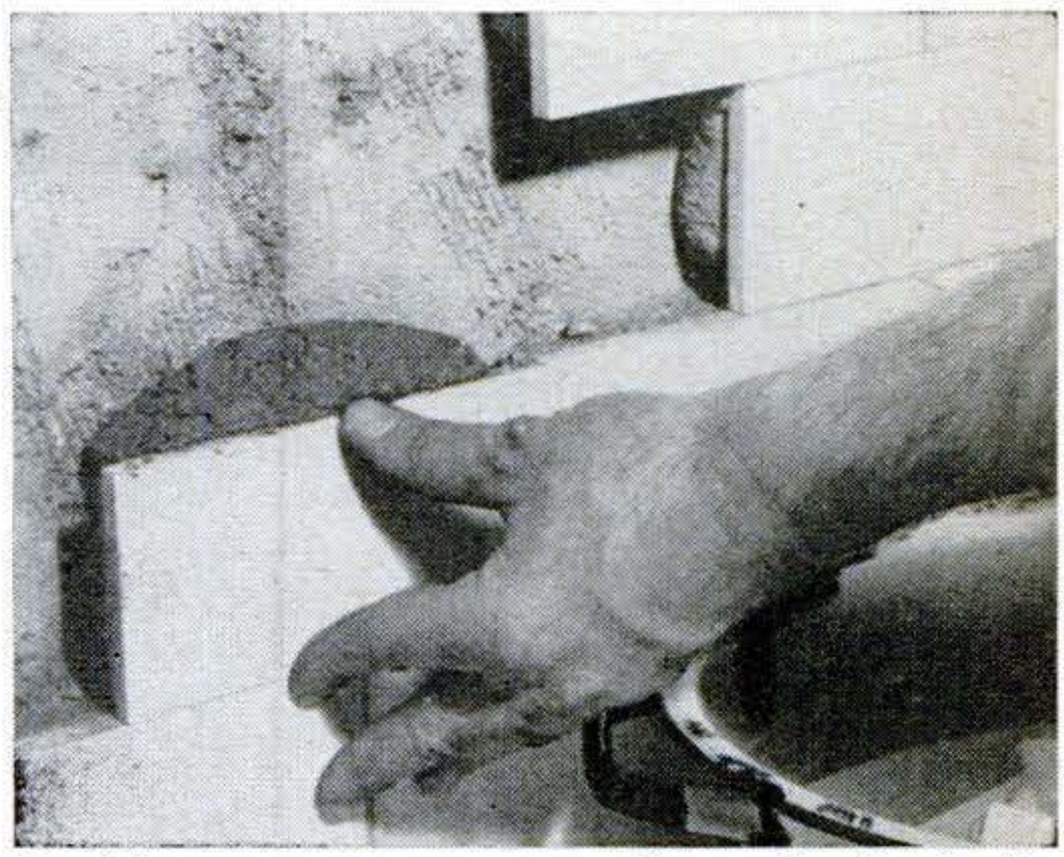
Then, with a sharp, flat chisel, carefully chip the tile free of the mortar. The first tile usually is the most difficult to remove, the others requiring little more than prying from their mortar backing. Use the flat chisel for this, inserting it behind a tile, perhaps tapping it easily, and then rocking it back and forth. You may have to do this at several spots along the edge. When all tiles have been removed, take the mortar backing off the wall in the same way.

If the wire lath on the wall is replaced, it will need a scratch coat to take the tile mortar. For the coat, mix four parts of sand with one of cement, adding water to bring it to a butter consistency. Trowel it on and let it dry for an hour. Then roughen the surface with a piece of lath.

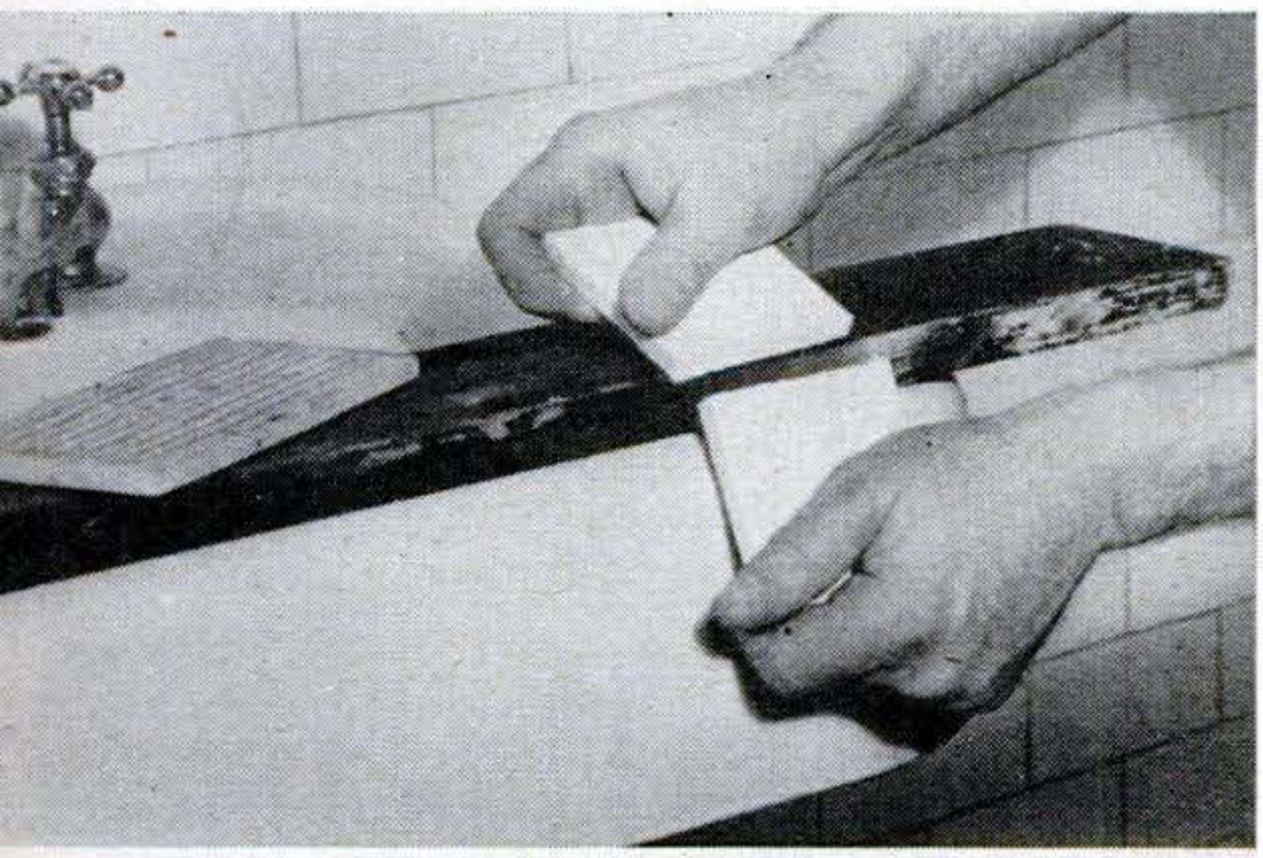
Clean the removed tiles and soak them in



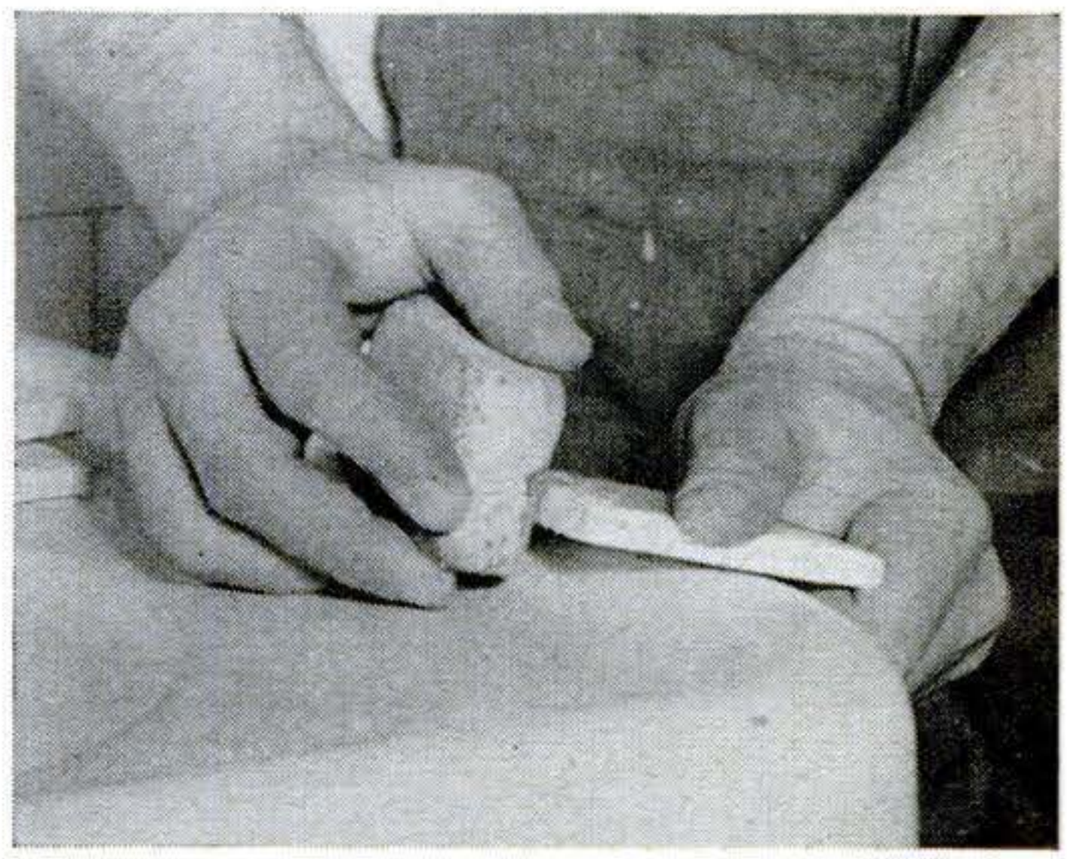
3. Lime paste is prepared by sprinkling lime into water slowly to avoid lumping. Sand and then cement is added to make mortar.



4. After mortar is scooped onto back of tile, tile is slowly but firmly pressed into place and given final setting by tapping with trowel.



7. A straight break is obtained by holding the scribed tile at each end and sharply striking it against the solid edge of a table or bench.



8. Edges of tiles trimmed to fit at end of a line or around obstructions—such as pipes—are smoothed with a whetstone or a file.

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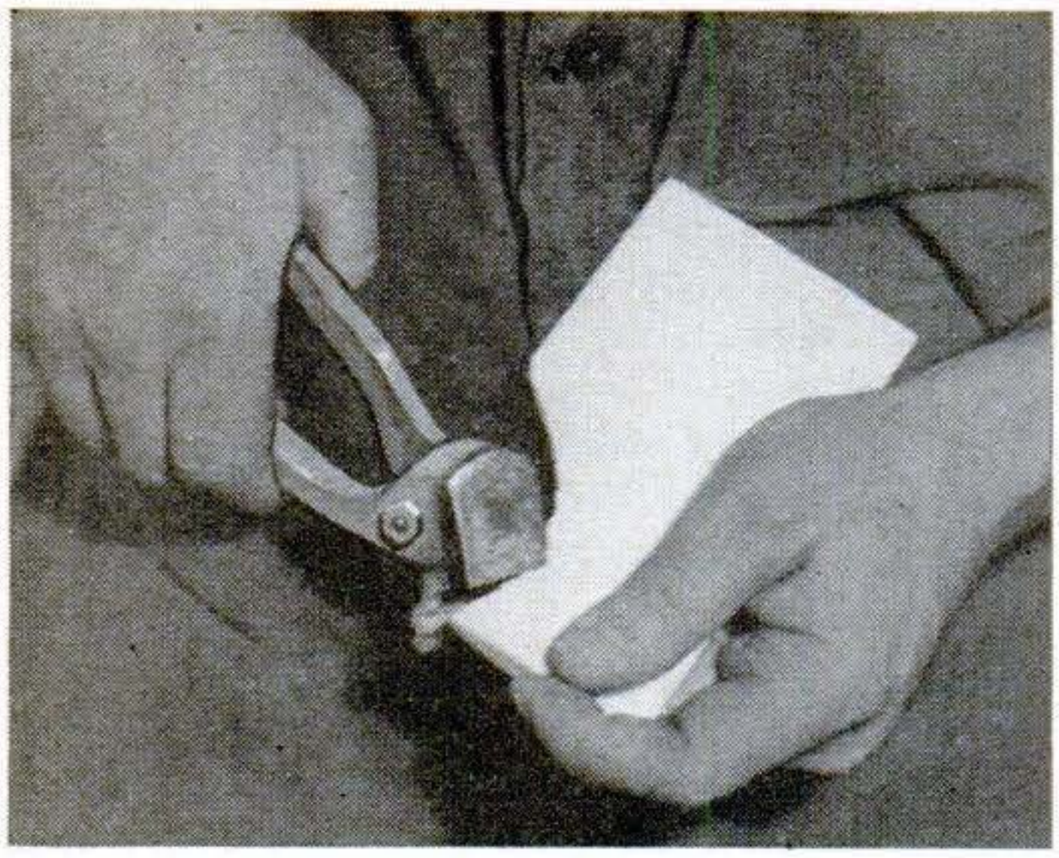
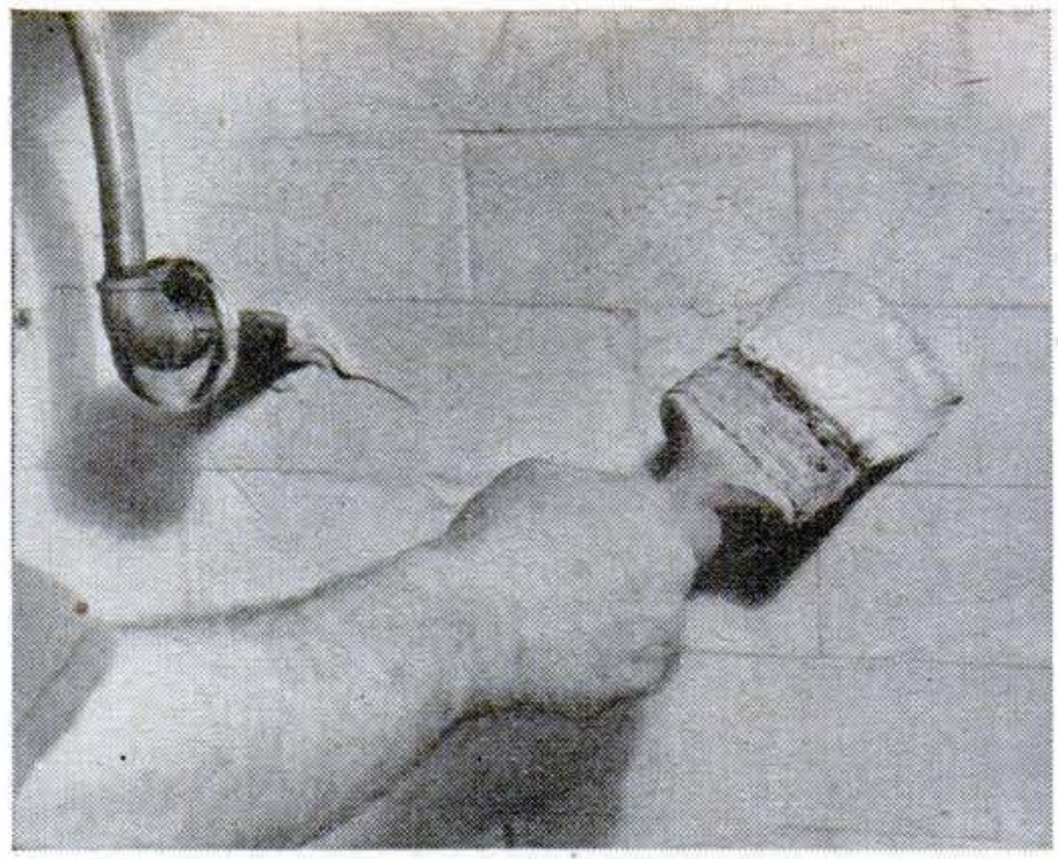
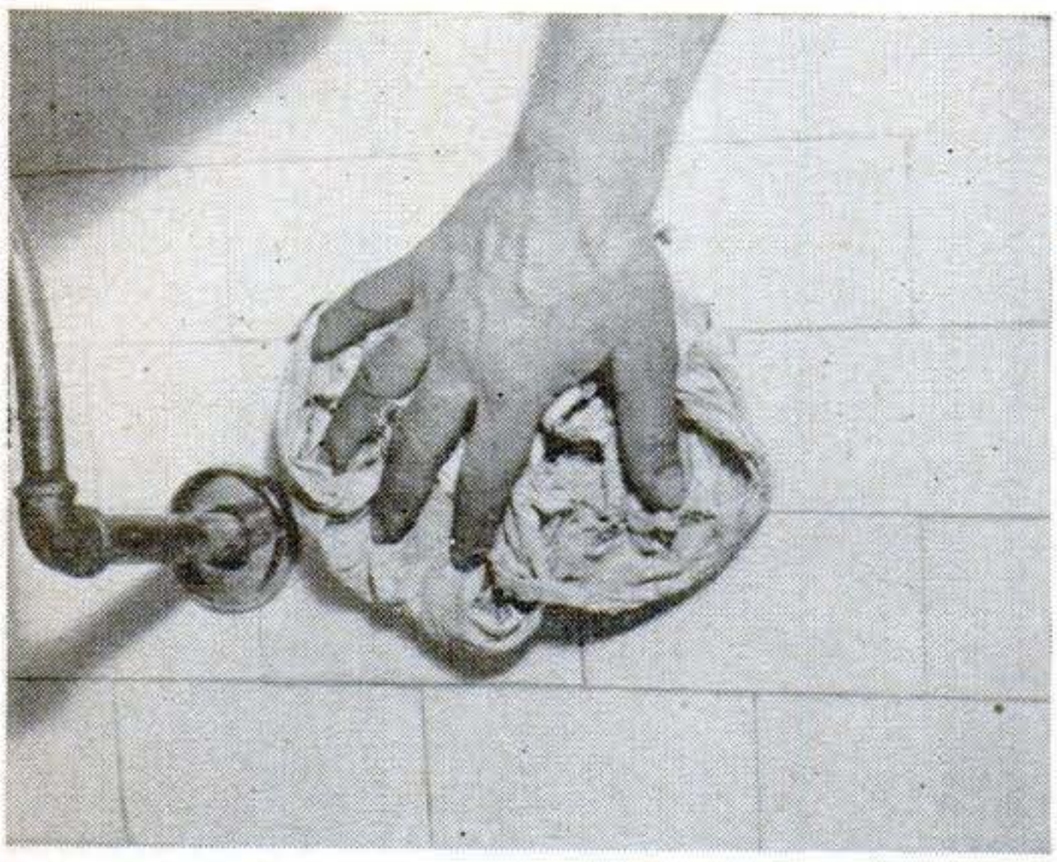


9. In making irregular cuts, outline is first marked. Pincers are then used to bite off small pieces until desired shape is reached.



10. Final step is filling joints with grout, a paste of white cement and water. It is applied generously. Make sure all joints are filled.



11. Immediately after applying grout, excess is removed with damp cloth or sponge. It may be necessary to go over area several times.

water until they stop bubbling. Tiles are porous and, if not soaked, will absorb moisture from the mortar, making a weak bond.

While the tiles are soaking, mix the mortar backing of six parts sand, two parts hydrated or finishing lime, and two parts cement. First prepare the lime by slowly sprinkling it into a container of water, until the water will hold no more. It is preferable, but not essential, to soak lime overnight. To make mortar, first mix the soaked lime and the sand. Then add cement. Add small amounts of water until the mortar is pliable and, when scooped up, will stand together. If you use too much water and find the mortar soupy, add more cement.

With the mortar ready, sprinkle the scratch coating with water. This prevents rapid drying of the mortar, forming a better bond between mortar and coating. Before applying mortar to the back of a tile, scoop a chunk against a vertical surface and, with an upward motion, let it roll off the trowel. Repeat until the mortar has a round shape. Rolling the mortar is important. The action forms a thin film of water on the ball and gives the mortar a clean, smooth surface, making a better bond between mortar, tile, and scratch coat.

Now you are ready to set the tile. Roll up a ball of mortar 1″ thicker than the distance from the back of the tile to the rough wall. Place it on a tile and scrape off the mortar for ½″ from each end of the slab. Begin at either end of a line, resting the edge of the tile on the top edge of the tile below. Push the tile almost into position and line it up by tapping with the handle of the trowel. Do not push it too far toward the rough wall. It is better for it to lean outward a bit from its intended final position.

After setting a row of tile, line it up with a straightedge. A 1″ by 3″ board that is long enough to extend an inch or so beyond each end of the row will do. Lay the board along the row and tap it with the handle of the trowel until the tiles are lined up. Press mortar behind any tiles that have been pressed in too far, bringing them out. With the board held in position, remove excess mortar, fill voids, and clean the top edge of the newly laid row.

When all the tiles have been set in place, go over the area with a damp cloth or sponge, cleaning it thoroughly. Next mix the grout by adding white cement to water until the mixture reaches a thick-cream consistency. Apply it over the entire newly tiled area. Then wipe off the excess. END

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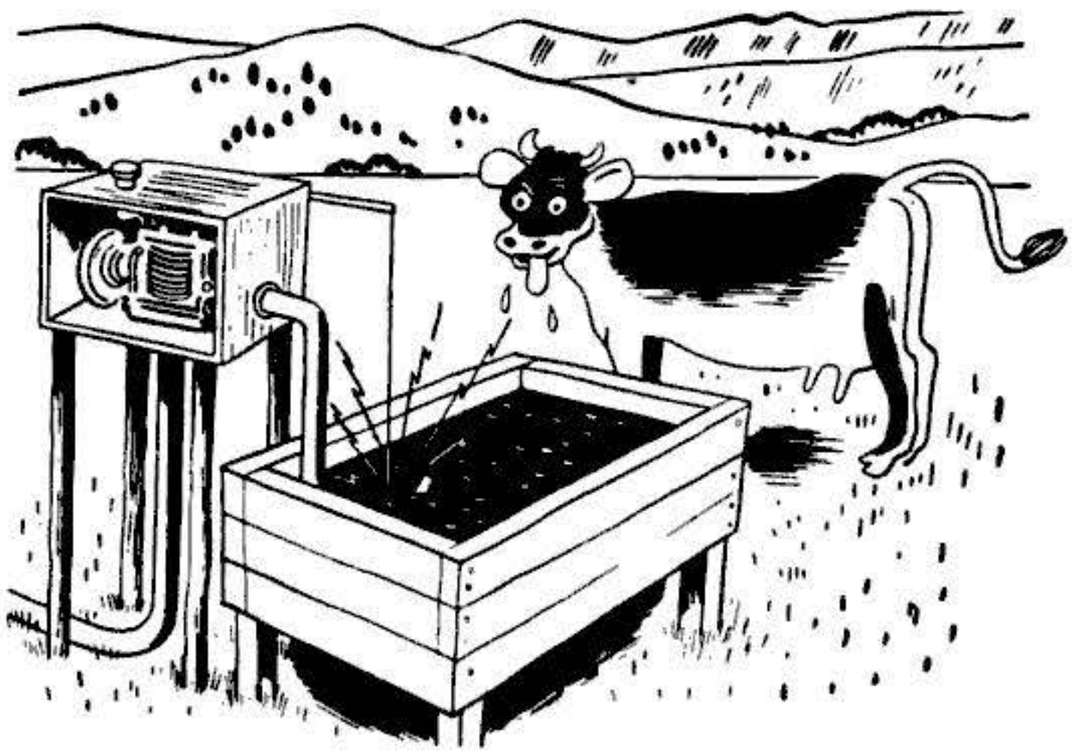
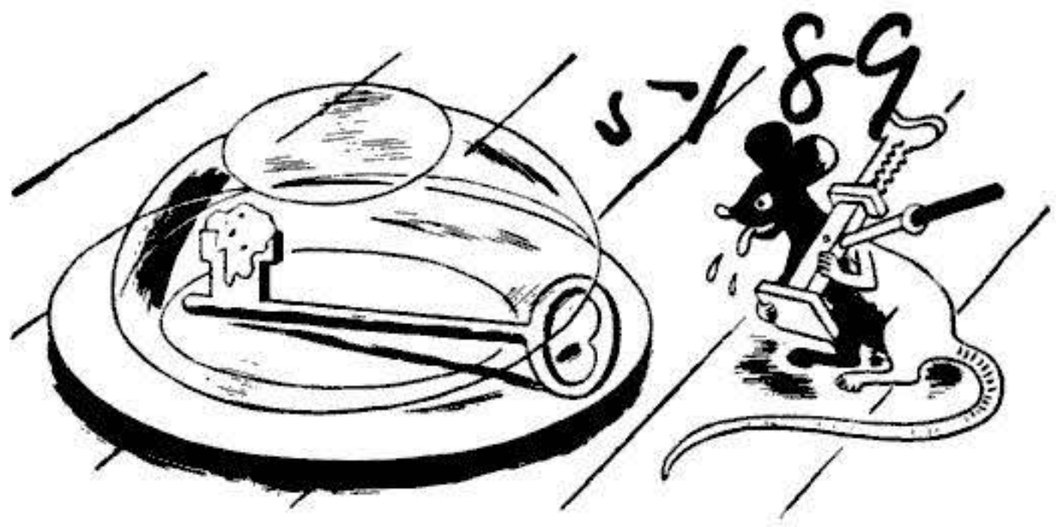
What's Your Ingenuity Quotient?



A short circuit can cause trouble, but I rigged one to save trouble. For an automatic stop on a magneto-type gas engine that pumps water in a distant pasture, I ran an insulated wire from the spark plug to the water tank. The wire ends near the top of the tank and the engine is grounded. Now when the water reaches the wire, it shorts out the engine.—*P. W. Kaltenbach, Long Valley, S. D.*

A hole in our fence lets rain water drain from the yard. However, stray dogs used the hole as a gate to come in and dig up my garden, while my dog used it as an exit to go wandering. So I built a sliding gate with an open can as counterbalance. When rain fills the can, the gate goes up and the yard drains. A small hole in the can empties it, lowering the gate when the rain lets up.—*W. K. Chi, Tangku, China.*

When I needed a table stand for a microphone, I found that a "plumber's helper" served the purpose well. I cut the handle down to the proper length and then, since I had no die, I trimmed the handle to fit the ⅝" socket on the mike. Vibration pick-up is reduced considerably by the shock-absorbing qualities of this stand and a coat of metallic paint does a little to conceal the stand's ancestry.—*Robert Hartung, Huntertown, Ind.*



We had a wise-guy mouse who thumbed his nose at all the usual traps. But he finally used a key to lock himself in this trap when he sneaked under the propped-up glass bowl to get the cheese on the end of the key.—*Roland Cueva, Manhattan, N. Y.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.

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5344

Collector Rings Feed Cord Reel

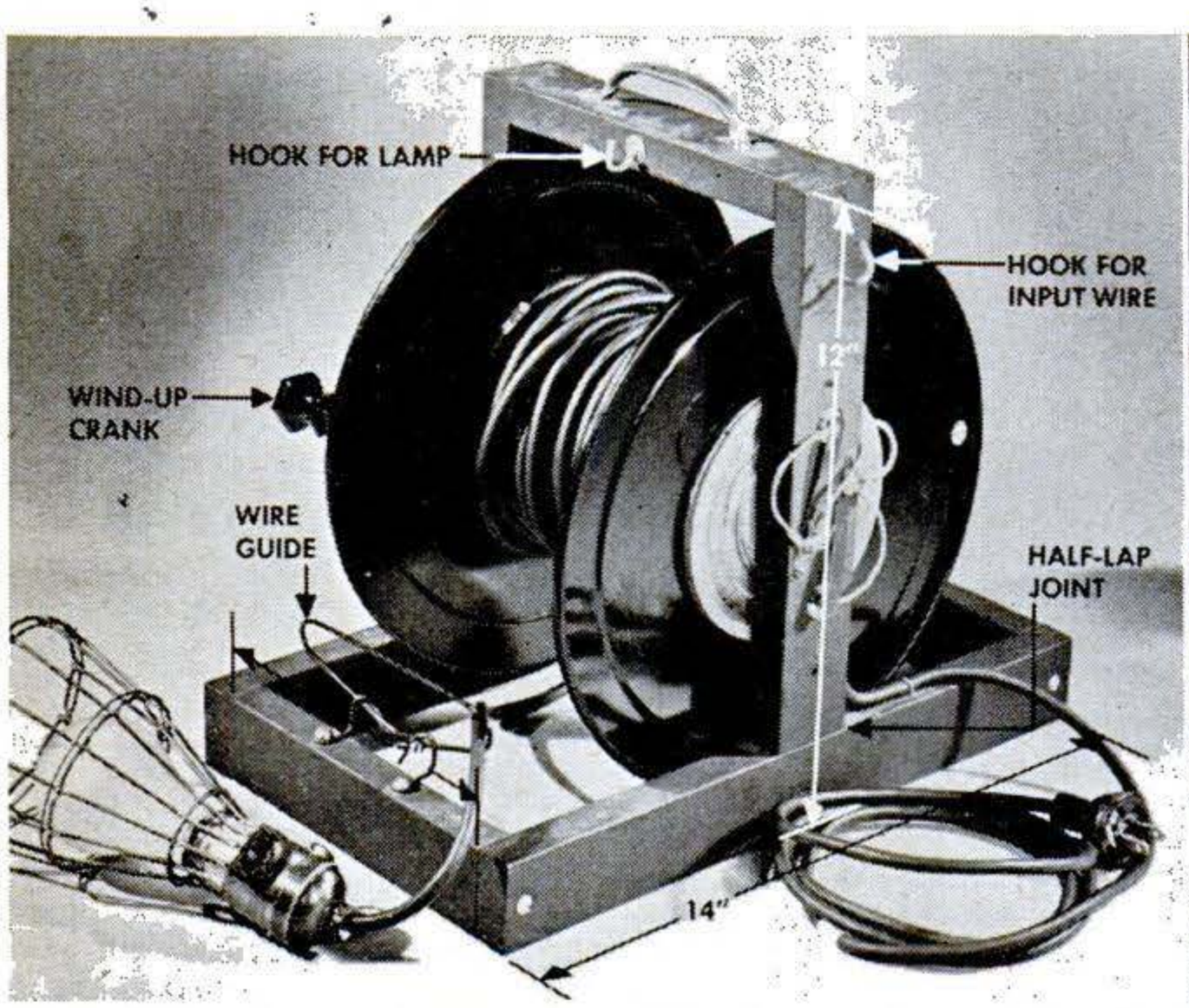
Reel takes up only small space, provides power and light hundreds of feet from nearest outlet.

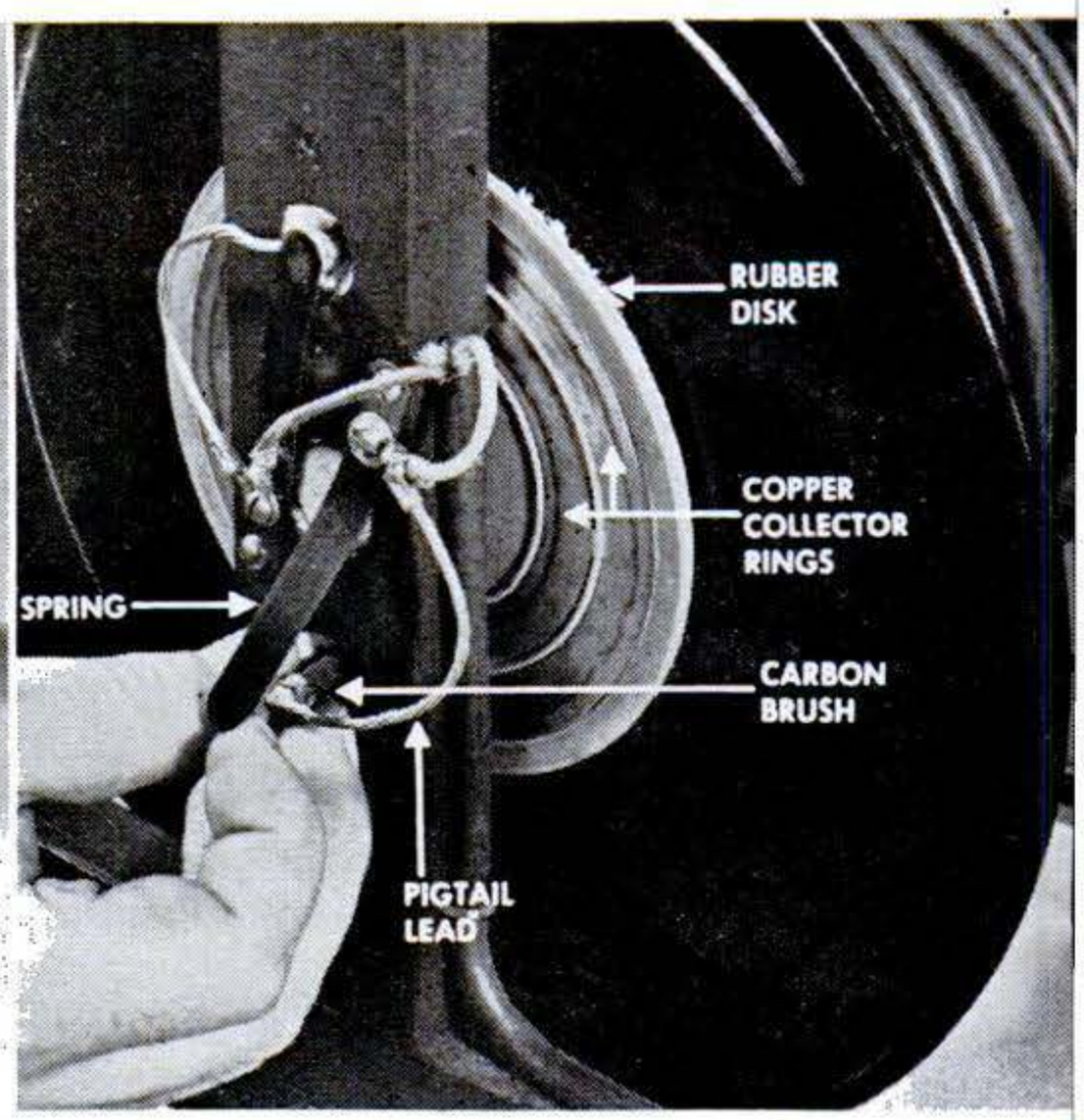
IF YOU'VE ever wasted time and patience untangling knots in a lengthy extension cord, you'll appreciate this homemade portable reel. Just place it on the floor, plug in the 6′ connecting cord, and walk away with the business end of the extension. Turning the crank rewinds the cord. The reel pictured here holds up to 500′.

The reel itself is one that wire is shipped on. I picked up this empty one in an electrical shop. It has stamped end disks with rolled edges, and the ends are solidly clamped to a core of steel tubing. I used a ¾″ hardwood dowel as an axle, which just fitted the holes in the end plates. An 8-32 bolt goes squarely through both core and dowel.

Current is fed to the cord through two carbon brushes riding on two collector rings. The brushes are old flashlight-cell carbons. The rings were cut from 16-gauge sheet copper to fit into the grooves of a soft-rubber sink stopper on the outside of one end of the reel. Another stopper is used inside the reel as an insulator.

Four 6-32 flathead brass machine screws were soldered to each ring at equally spaced points around the circumferences. Matching ¼″ holes were punched in the rubber disks, and drilled through the end of the reel. Each screw was insulated from the end of the reel by hard-rubber tubing. Washers and nuts were fitted to the screws and the ends sawed off flush with the nuts. The reel end of the extension cord is attached to two soldering lugs, one under a nut on each ring.





Protective cover is here removed to show collector-ring assembly. Springs that hold carbon brushes to rings were cut from old corset stay, while the insulating disks are soft-rubber sink stoppers. Note how 6′ input wire is stapled to frame to avoid any strain on electrical leads.

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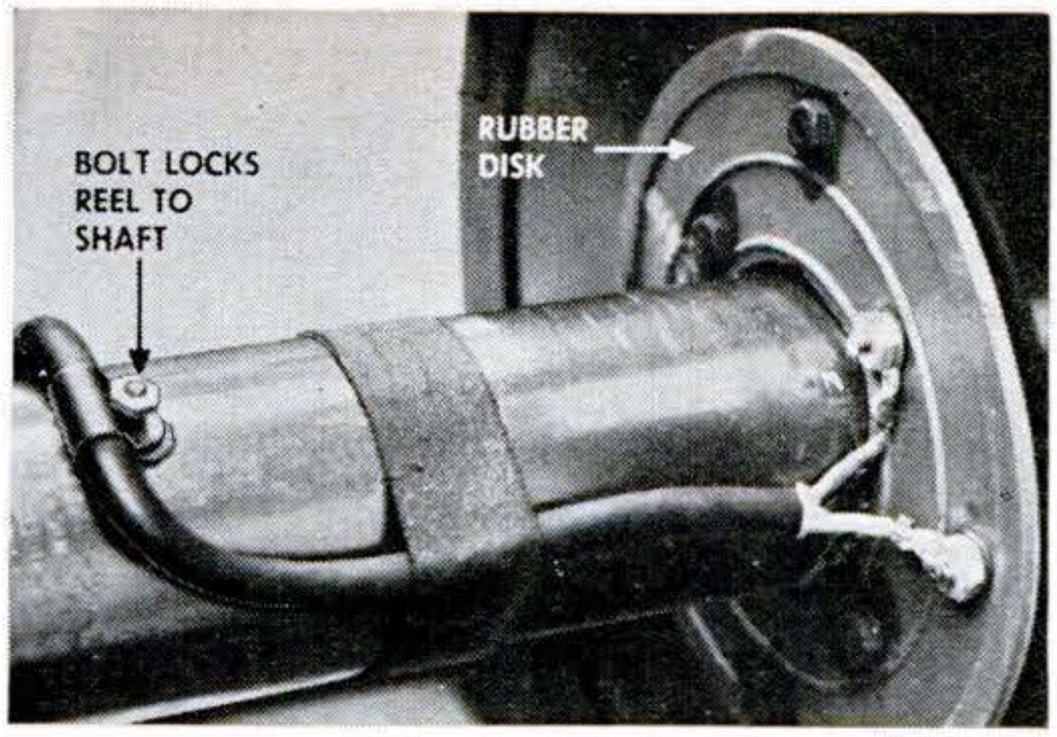
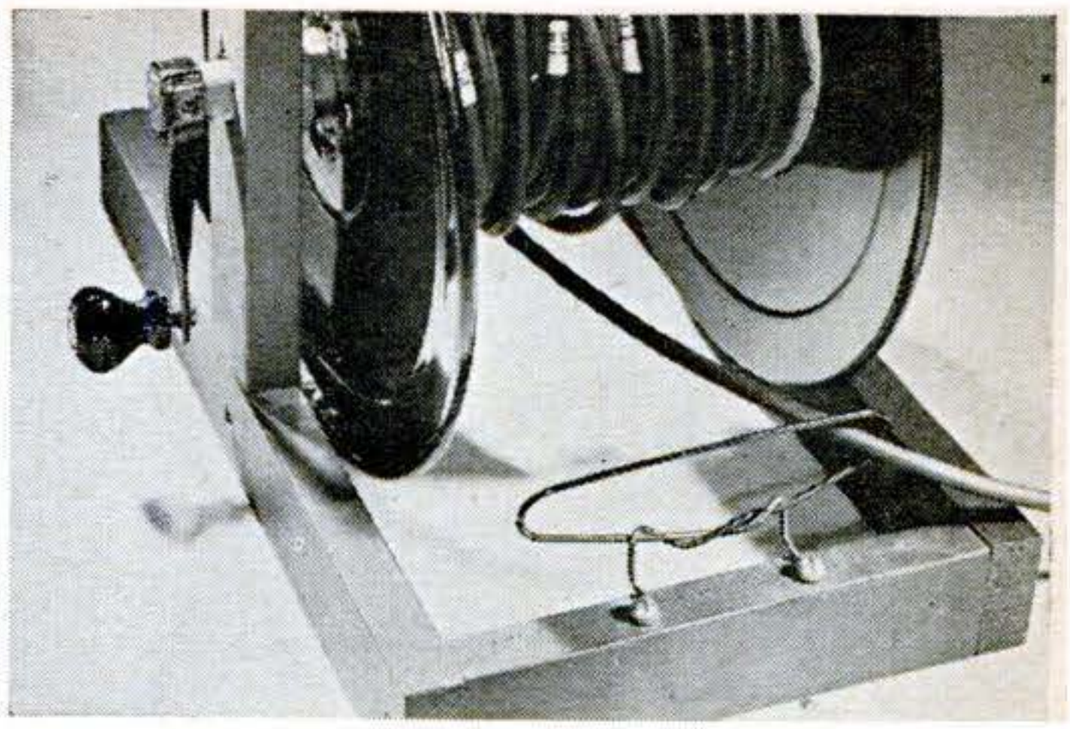


A through bolt anchors reel to central dowel, and a clip under nut also holds the cord end.



Guide bent from a heavy wire coat hanger aids in even rewinding of extension cord on reel.

A ¾″ hole was cut in the outside rubber stopper to clear the axle. The inside stopper has a bigger hole to clear the reel core, and was slit so it could be fitted on without disassembling the reel. Remember that the nuts on the inside of the reel are "hot." Although there is no reason for handling this part of the reel, it might be wise to insulate them by covering with a third rubber stopper.

Leave the brass caps on the flashlight carbons so you can solder pigtail leads to them. Two ¼″ holes were drilled through the vertical frame member to take the carbons. These holes are counterbored for the larger diameter of the brass caps. Two strips of spring steel from a corset stay (clock spring would do as well) hold the carbons firmly against the rings. Two small wood screws hold these springs to the frame. Soldering lugs under two of the screws serve as connections for the 6′ plug-in cord to the pigtail leads from the brushes.

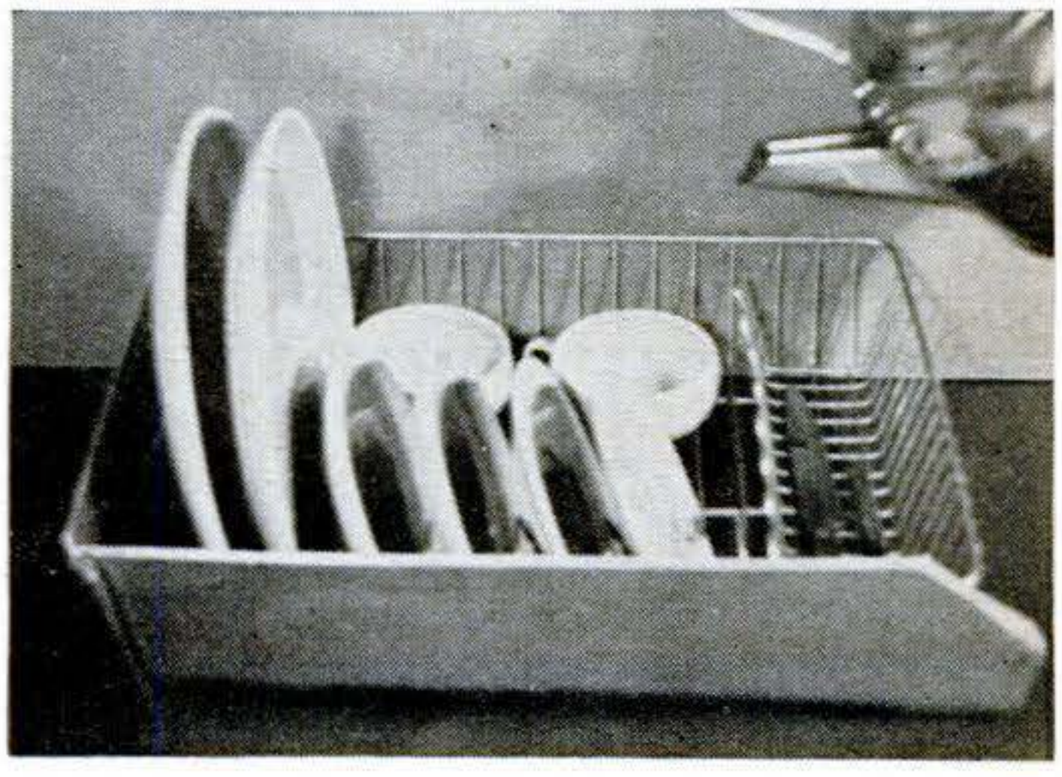
The frame shown here, for a 6″ by 10″ reel, is made of ¾″ by 1⅝″ white pine and assembled with flathead screws. A coffee can furnished material for the cover that protects the collector-ring assembly. It is held in place by two small screws into the vertical frame member.

Before final assembly, the frame was given two coats of flat black paint. A drawer handle was fastened to the top crosspiece, and large cup hooks were set to hold the coiled plug-in cord and the extension cord socket. The crank is a piece of strap iron, drilled for an anchoring screw to the axle. Rewinding the cord is helped by a guide bent from a wire coat hanger. Its width should be slightly less than that of the reel.

The cord used on the reel should be rubber- or plastic-covered and round in shape. Stranded No. 18 two-conductor cable will serve for general purposes. Any conventional socket may be used, but a wire-guarded socket with outlets on the sides is especially convenient. For extra-rough service, such a socket can be had jacketed in soft rubber. If you want to be really fancy, a fuse block and a pair of 5-amp. fuses may be installed on the input line.—*Gilbert Sonbergh, Hollywood, Calif.*

Guard on Dish Rack Stops Splashing on Floor

THE simple, two-piece gadget pictured at right will stop lots of splashing when dishes are rinsed. Make it of aluminum or other nonrusting sheet metal, forming a lock joint to connect the side and end. If necessary you can cut tabs to anchor them on the drainer. Thin waterproof plywood finished with enamel may also serve. No extra storage room is needed for the guard since the two flat pieces may be laid in the rack when not in use, or hooked on if the rack is hung up for storage.—*Robert Hoppough, Waukegan, Ill.*



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5314

Roll Your Own Camp Table

CAMPING trips and picnics are more fun when you carry along portable furniture. The Cam-Pic® table, with benches to match, may be unrolled in a few minutes. No nails, screws, or bolts are needed. The table legs unfold like a cot. Slats, held by webbing and metal fasteners, fall into place as the top is unrolled. Wrap the top around the legs and you're ready to move. Packed in its carton, the table weighs 18 lb. and forms a package 3′ long. Gro-Sales, Inc., Los Angeles, is the maker.

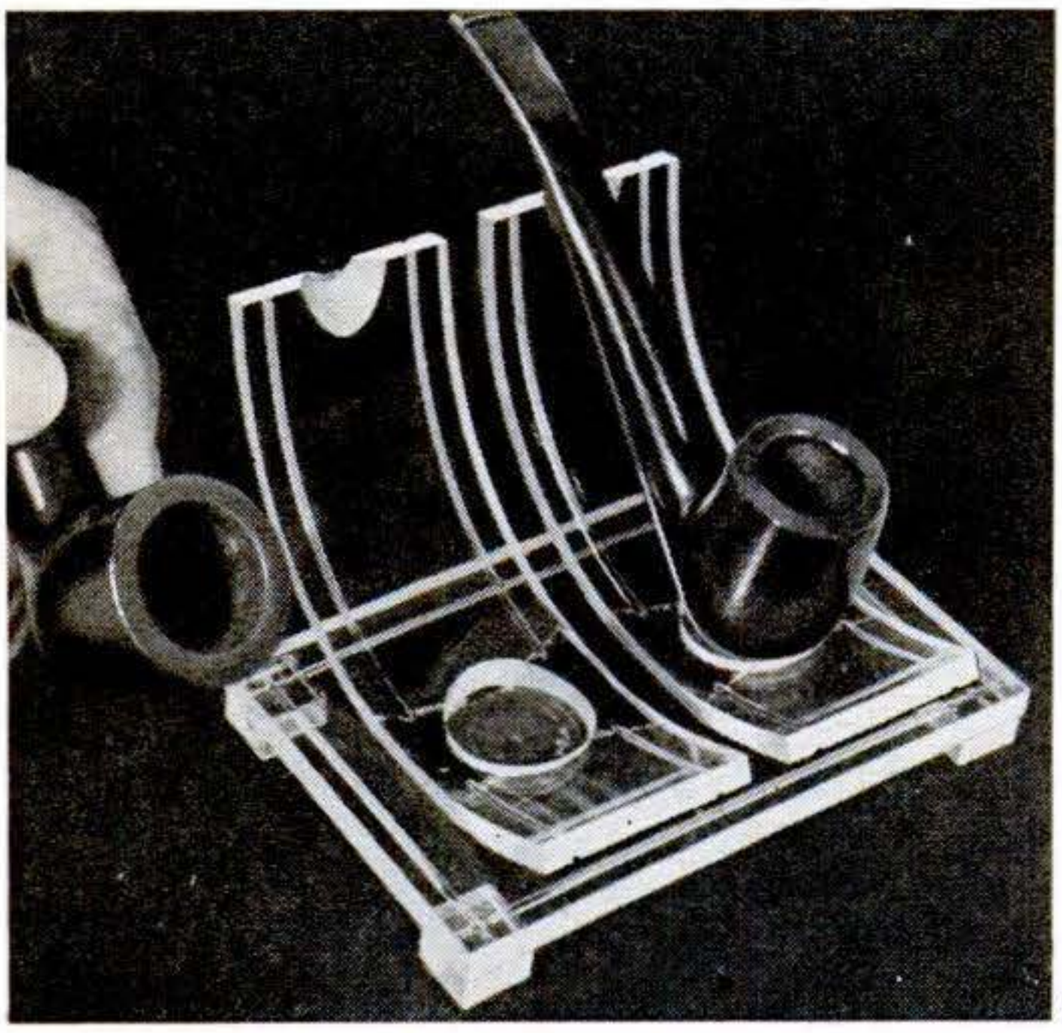
Brush Guard Protects Hands

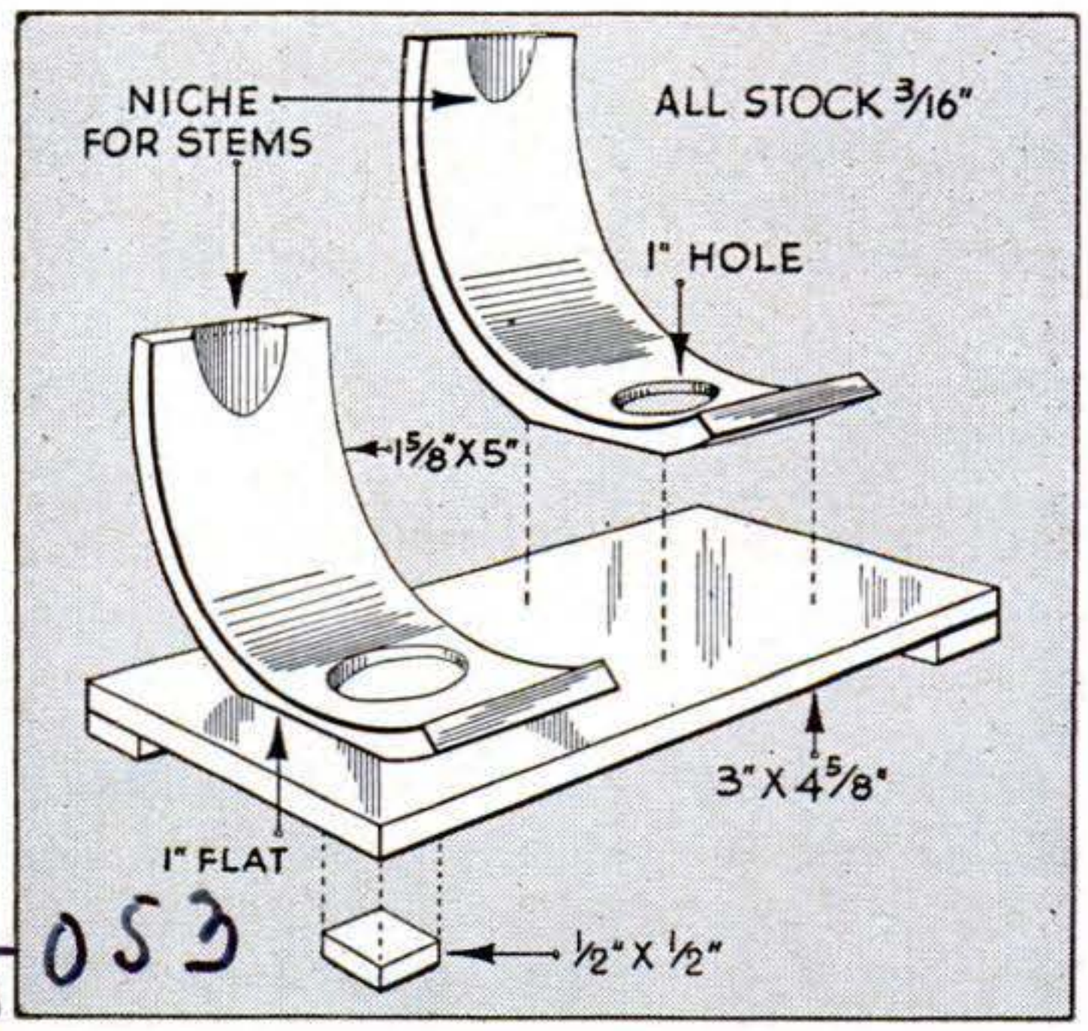
A RUBBER jar opener, the kind that can be bought for about 10 cents, makes an excellent protector for your hands when painting a ceiling or any other overhead parts of a structure. It will slip over the handle of the brush, catching drippings that otherwise would run onto your hands. Such jar openers have a ¼″ hole in the center. The hole may be enlarged so the rubber won't tear if the opener is forced over large-handled brushes.

5374

Oil Stops Hand Chapping

IF YOU have to do an outdoor chore in cold weather—a job for which you can't wear gloves—castor oil will prevent chapped hands. Rub the oil well into your hands before starting work and again when finished. —*Paul H. Graham, Manchester, N. H.*





5053

Clear Plastic Pipe Rack Is One-Evening Project

THIS modern, transparent pipe rack—a useful ornament for your desk—is made entirely of 3/16″ thermoplastic. Lay out the base first, and then cut the two pieces that are to hold the pipes. Before bending them, cut the niches, holes, and decorative grooves if desired. Center the holes about 1¼″ from each end. After heating the two pieces in the oven, bend them around a 4½″ tin can. When they are cold, grind or file a 1″ flat across the bottom of each to get a good cementing surface. Be sure the flattened areas are alike so the curved strips will line up when mounted. Cement ½″ by ½″ squares to the corners of the base as feet.—*Will Stoll, Elmhurst, Ill.*

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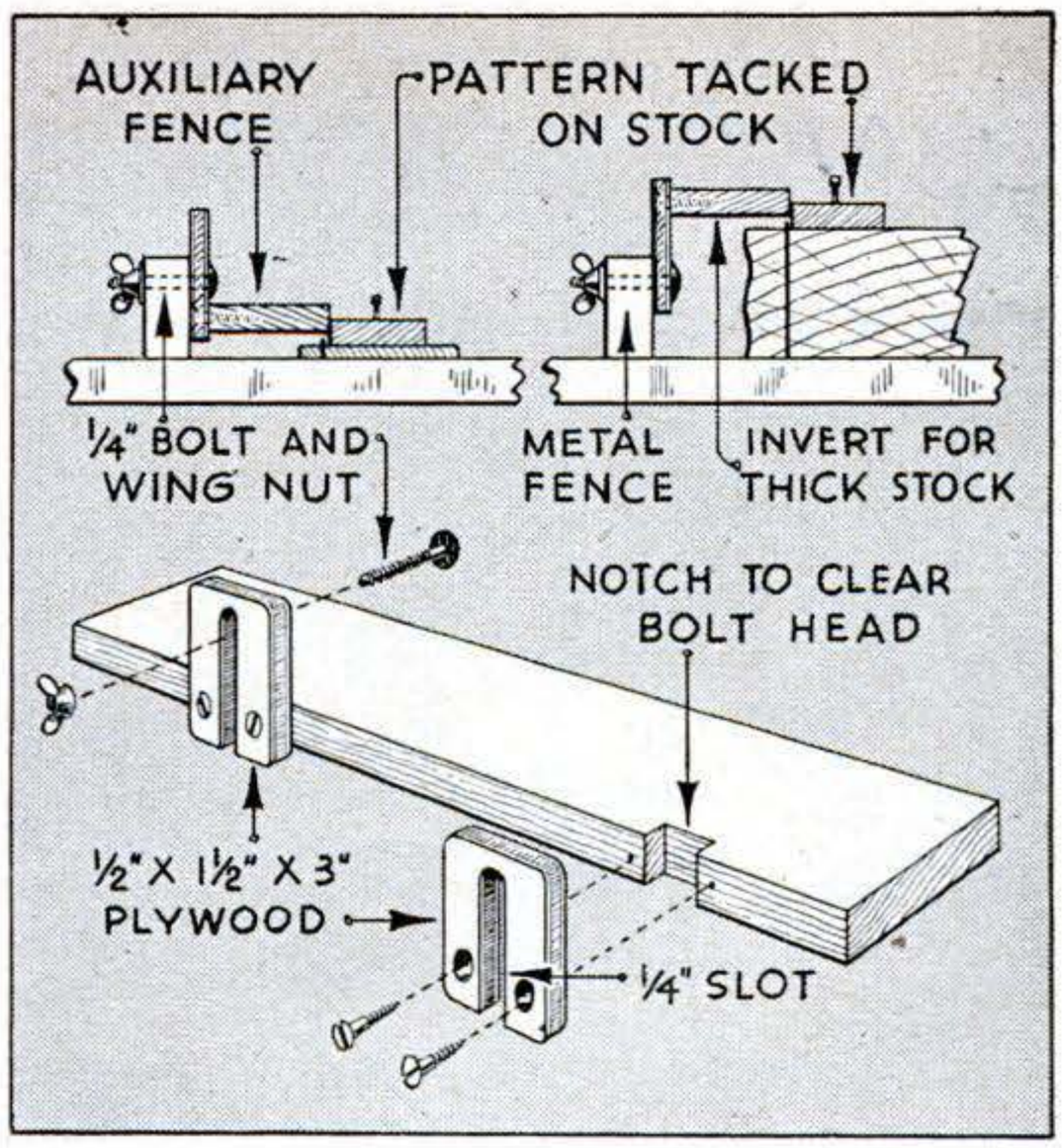

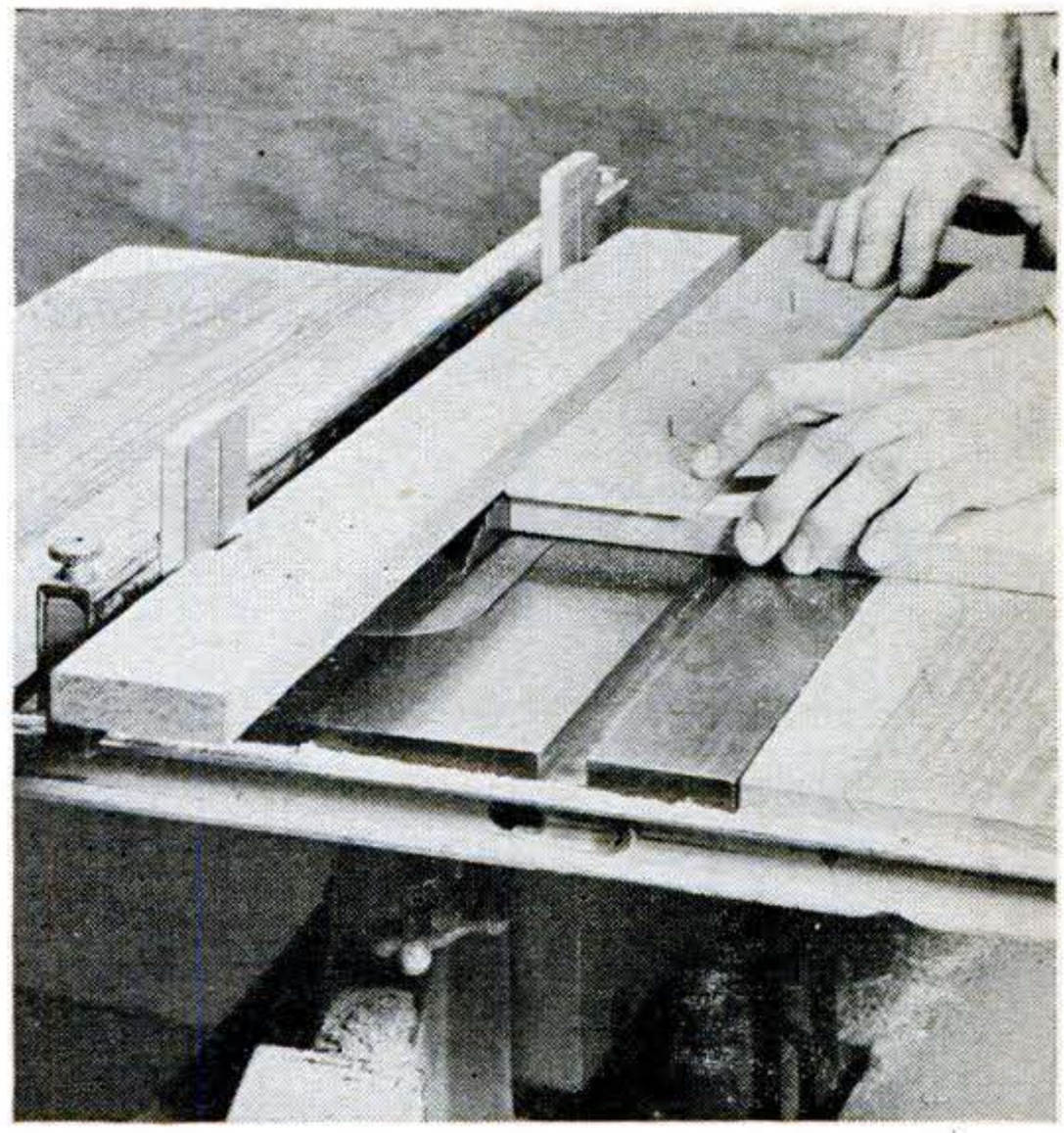

Circular Saw Has Movable Fence for Pattern Cuts

I HAVE found that the adjustable fence shown above simplifies duplicate pattern sawing on a circular saw. It can quickly be mounted or detached, and it will take stock from ¼" to 2¼"; just invert it for the thicker work.

Make the fence any convenient width and length, countersinking the woodscrews that hold the brackets to it. When you're ready to use it, set the outer edge, along which the pattern is slid, flush with the outside of the saw teeth. Then tack a thin pattern on the work to serve as a guide. Work of any shape with any number of straight sides can be cut by means of this technique—*Glenn A. Wagner, Delmar, N. Y.*

5416

Cork Safeguards Fisherman's Key Ring

WHEN boating, fishing, or working around water, it's a good idea to take this simple precaution against losing your keys overboard. A large cork strung on the chain will keep two or three keys afloat if they should fall in the water.—*Ronald Eyrich, Milwaukee, Wis.*

Birds Feed from Salad Bowls

ALL the parts you need for this quickie project are two wooden salad bowls, a few feet of small chain, and seven screw eyes. The chain should be brass, copper, or some other nonrusting metal. Chain about the size of that used on the draft control of a furnace will be about right.

Space three screw eyes around a 1" circle in the inside center of the larger bowl. Then set three more screw eyes around the inside rim of the other bowl. Pry open the eyes enough to hook the ends of the chain in them, and then squeeze them shut. Cut the chain so there is about 4" between the rims of the bowls. Use a larger screw eye for the chain to hang the completed feeder.—*Arthur Trauffer, Council Bluffs, Ia.*

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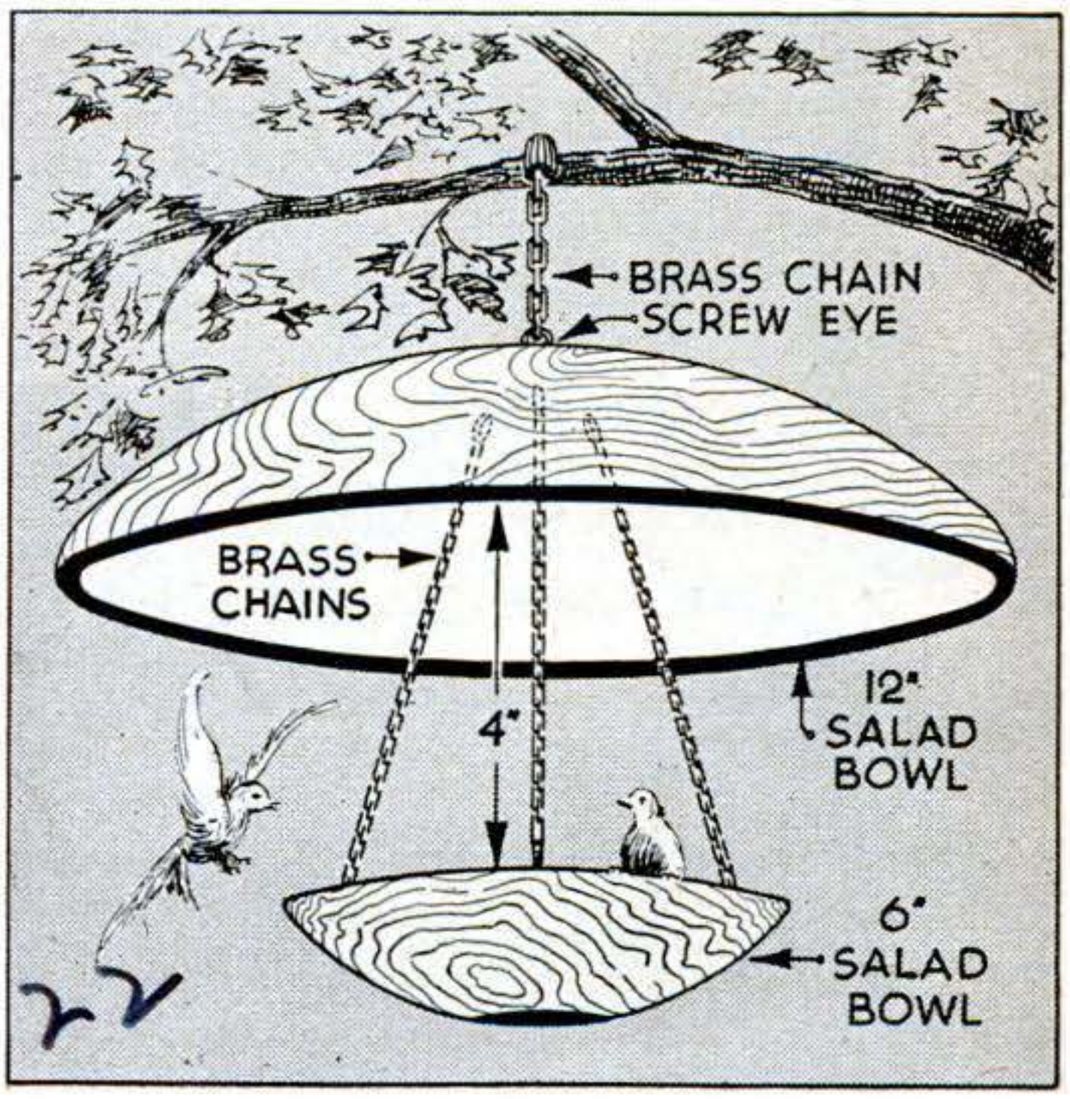

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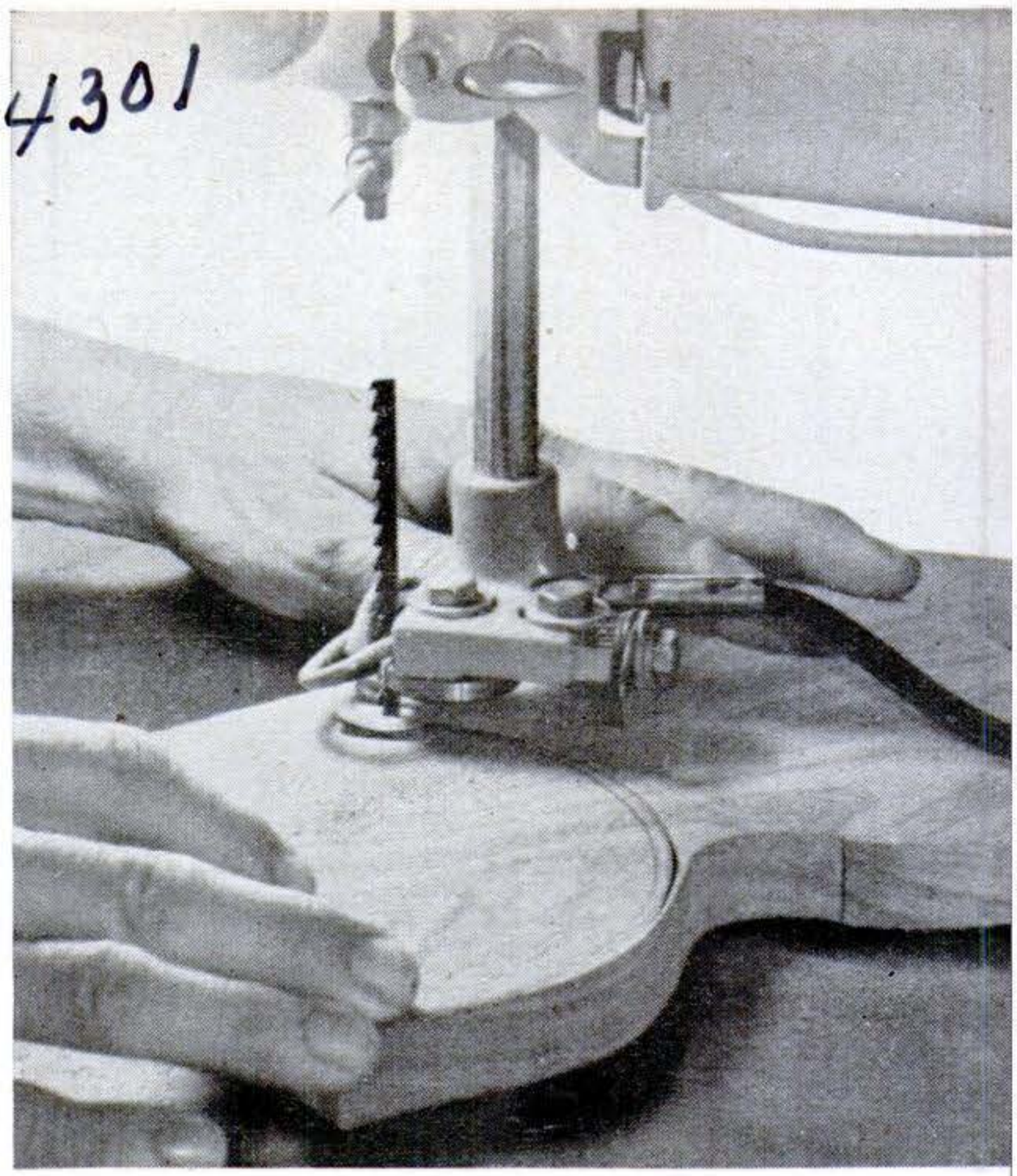
Cutting Holes and Disks with Power Tools



There's more than one way to swing a circle. Here's how to do it on the bandsaw, jigsaw, shaper, or lathe.

By Edwin M. Love

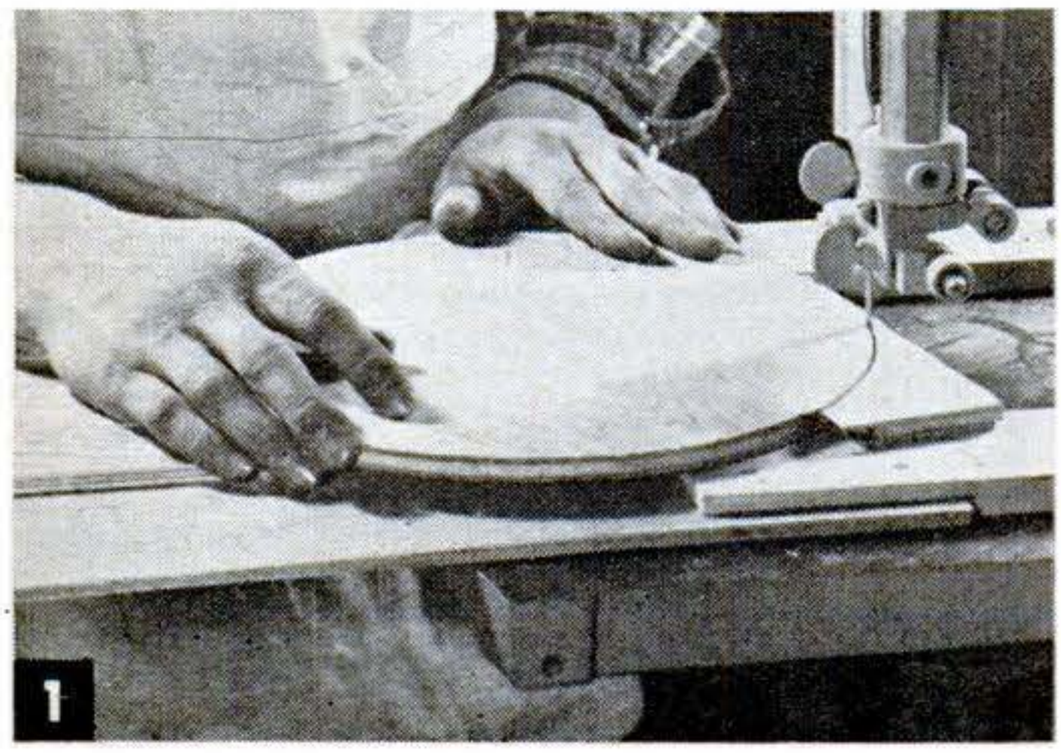
IT'S FARTHER around a disk than you think, as you often discover in cutting one with hand tools. Power tools are not only faster, but with jigs make precision a matter of course. Lazy Susans, lamp bases, and similar disk shapes are interesting chores for several power tools.

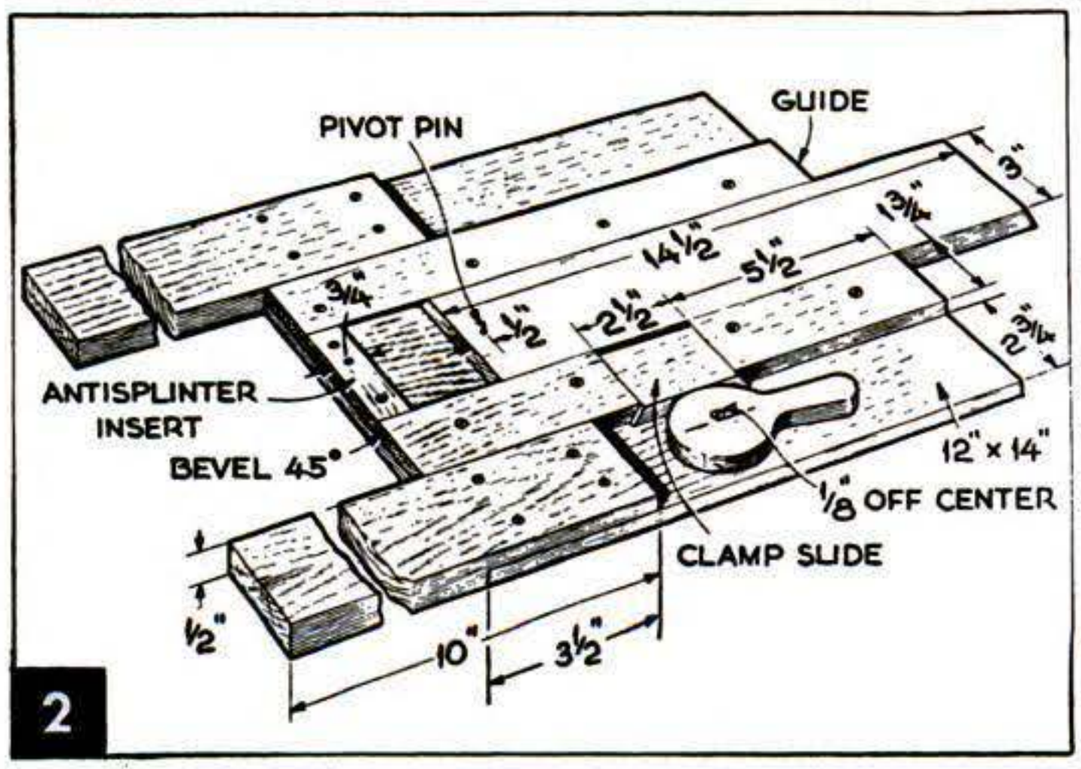
For anything but rough work, smooth the stock first almost to thickness. The slight excess can be taken off after cutting, along with any splinters that may be left. Scribe the circle with dividers.

The bandsaw is tops for fast disk cutting. If only one or a few are wanted, they can be cut freehand. Be sure you use a blade narrow enough to turn in the disk radius. A ⅛″ blade will cut a curve as small as ¼″; a ¼″ blade will go down to ¾″ radius, while a ½″ blade shouldn't be turned in much less than 1½″ radius. There's no harm in using too narrow a blade, but it may cut slower and tend to wander more.

A circle is a line that changes direction at every point. So in sawing one the blade must constantly change direction, and you must feed in only by turning—never by pushing the work in straight. The secret of cutting disks free-hand is to keep turning the stock on an imaginary center that is fixed on the saw table. This pivot point lies on a line at right angles to the blade width, drawn from the tooth line.

Splintering of the underside is lessened by running a board into the blade until it's





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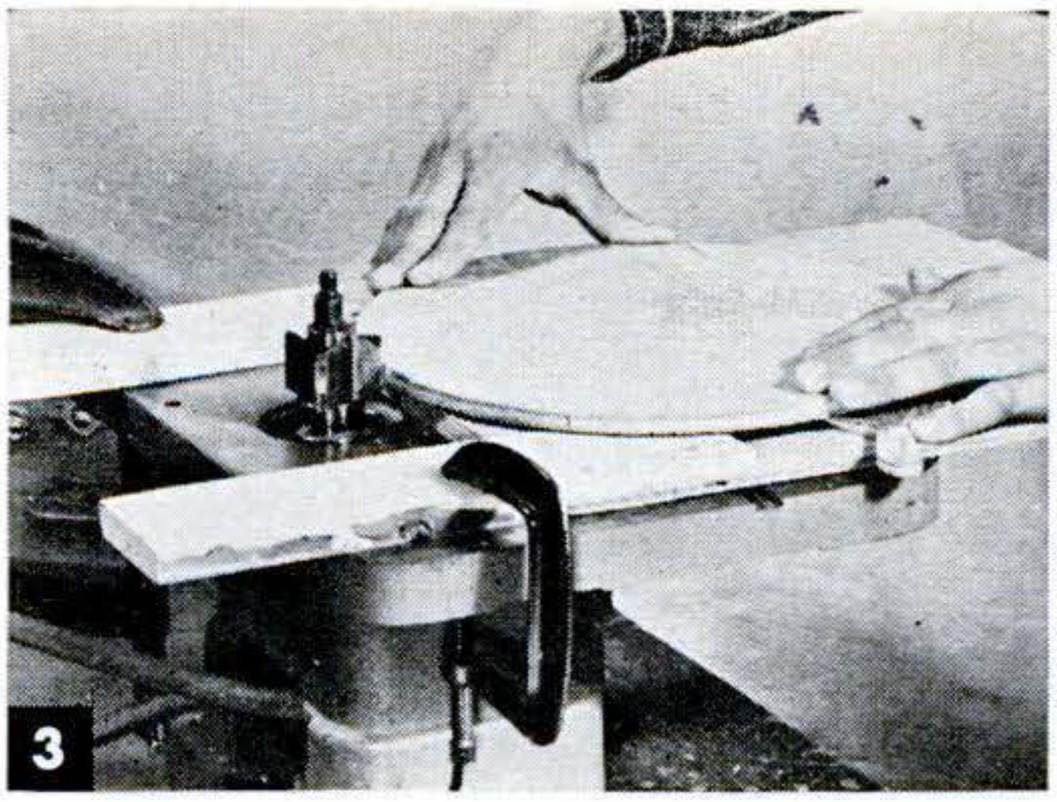

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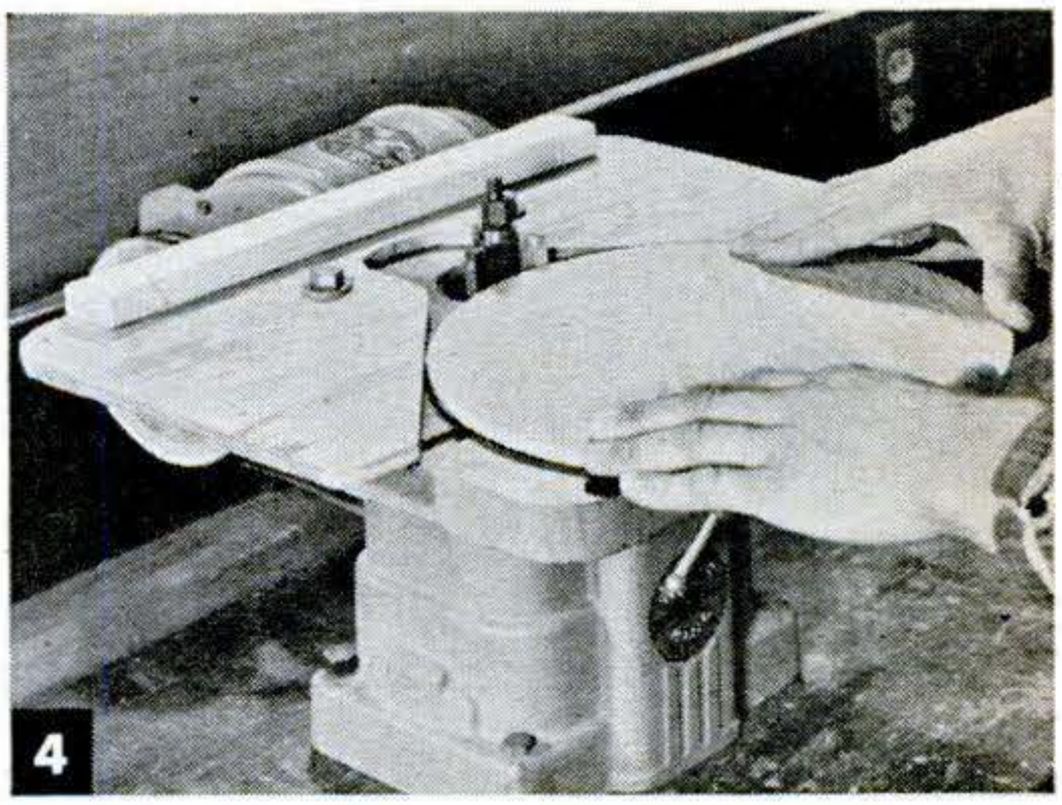

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centered on the table, and clamping it there. The kerf gives support close to the teeth.

Exactly the same points apply to jigsawing disks. The jigsaw will equally well cut a smooth inside hole, where the disk is the waste. It's also ideal for tricky cutouts where disk and hole are to be refitted, as in making a loudspeaker panel and grille. Saber saws—wide, stiff blades that fit into the lower chuck only, as shown at the top of the facing page, do fairly fast work.

A pivot jig, shown in use on a bandsaw in Fig. 1 and detailed in Fig. 2, cuts duplicate disks fast. No layout is required; once it's set for size, disks are cut just by turning the stock against the blade. The jig is clamped to the bandsaw table close to the blade, with the pivot pin aligned as explained above. Lock the dovetail slide with the cam to hold the pin at the desired radius from the blade. Press the stock on the pin (making sure there will be wood all around the circle you're going to cut) with an edge touching the blade, and swing the piece into the teeth.

If your saw blade "leads"—tends to cut to one side rather than straight—the pivot point may have to be shifted a hair one way or the other. If the blade pulls inside the circle, move the jig a bit back; if the blade tracks outside, move it a trifle forward. Blade lead can often be corrected by adjusting the guides or resetting the teeth.

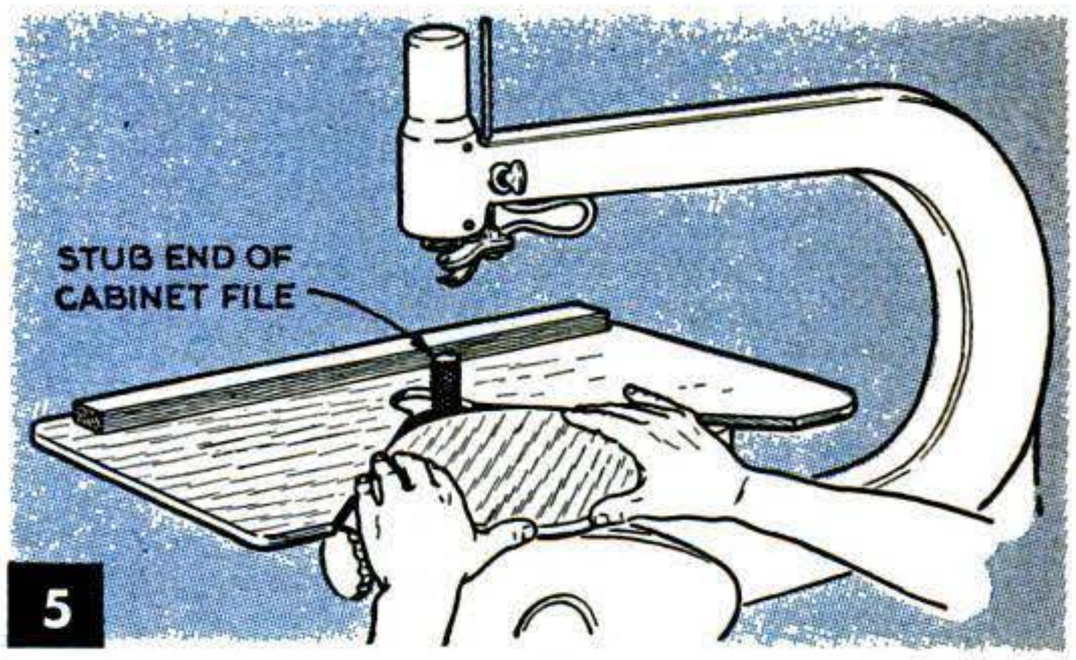

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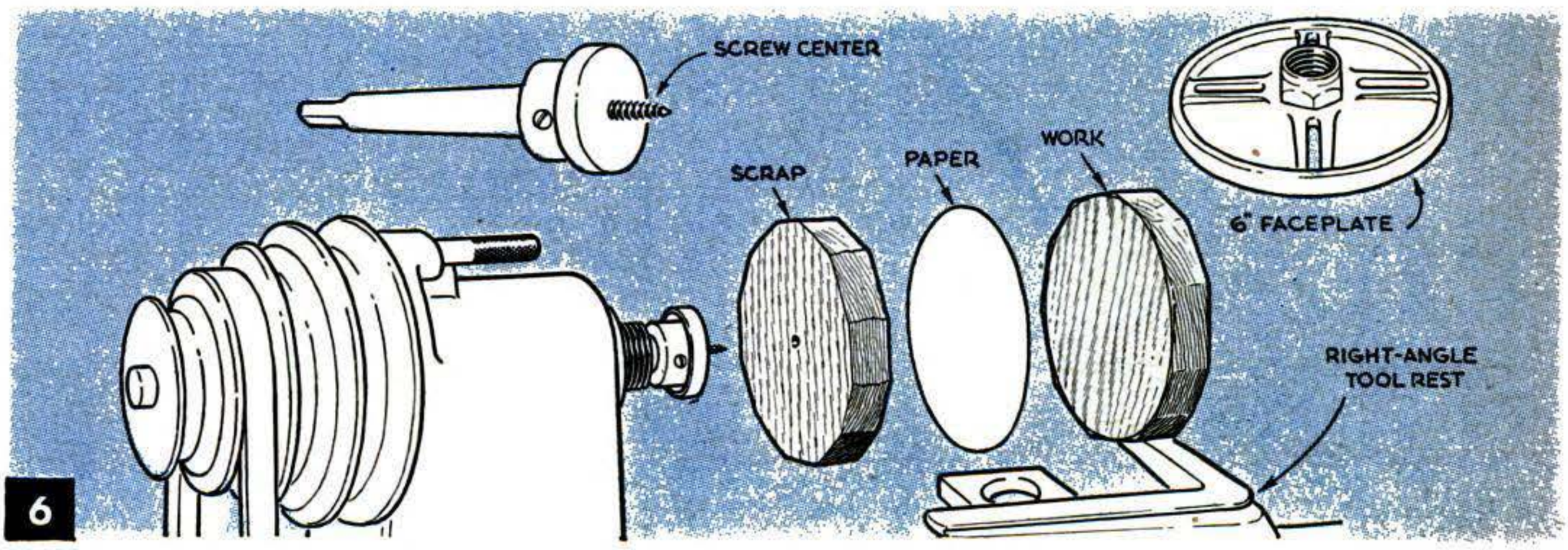
Figure 3 shows the jig used for finishing a disk edge on a shaper. Mount a straight cutter on the spindle, and clamp the jig to the table. With the machine running, push the slide forward to cut the desired radius, and lock the cam. It's a good idea to start the cut with the grain and, as usual, advance the work against cutter rotation.

With both a bandsaw and a shaper, you can rough-cut disks freehand on the saw and finish them quickly to size with the jig on the shaper. Of course you can also mold



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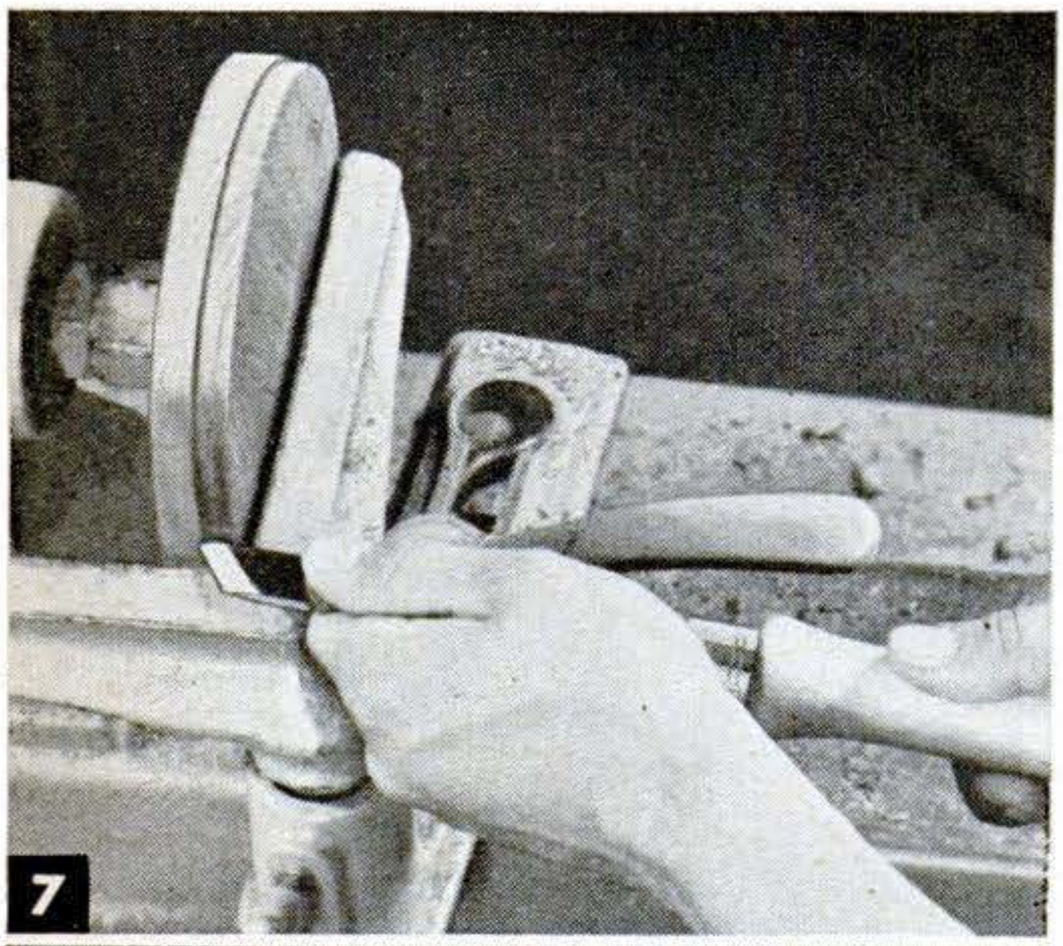

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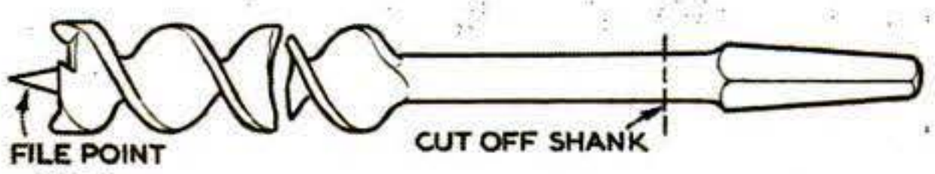

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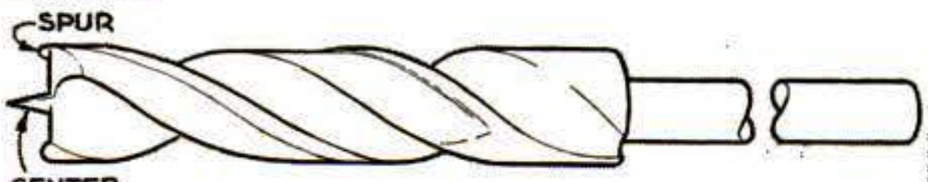

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or rabbet the edge with a suitable cutter on the spindle.

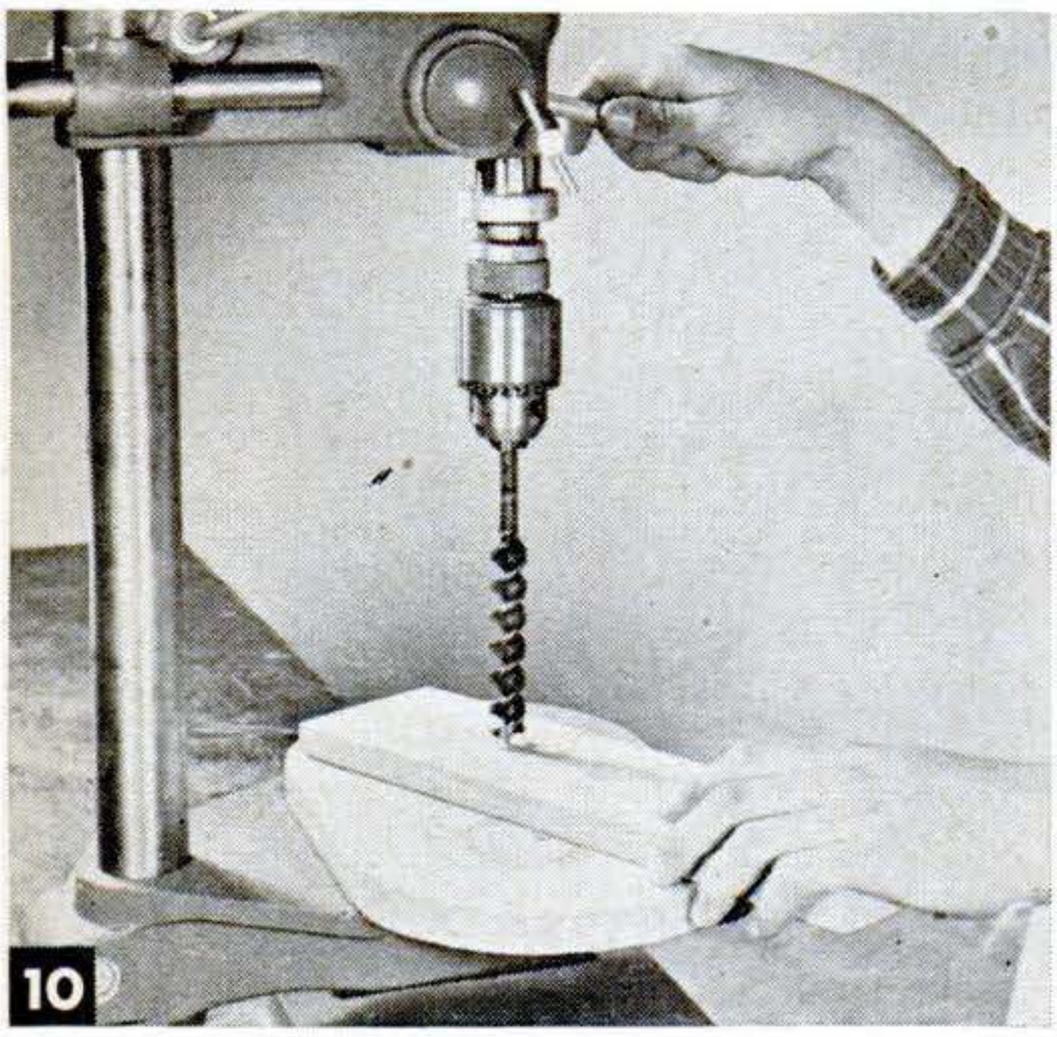
On the drill press, the same jig can be used for shaping or, with a sanding drum, for edge sanding. Don't run the drum much above 2,000 r.p.m., or the work may be scorched and the abrasive paper glazed.

A simpler jig for sanding, shaping, or filing the edges of disks is shown in Fig. 4. It's just a 90-deg. V-notch cut in a board and enlarged at the throat to receive the cutter or sanding drum. Any size disk that will fit inside the notch can be worked. But the disk must be accurately cut round beforehand; since the jig guides the work by the edge, any inaccuracy is transferred and the device is useless for rough-cut disks. For this reason, too, cuts should be shallow. It's wise to mark the place you start; otherwise you may go around spiralwise in a decreasing circle. Figure 5 shows the jig used for jigsaw filing.

Circle cutters are fine for making toy wheels or wooden washers. Most require a center hole, or make one themselves. Use a slow drill-press speed and feed cautiously, with a backing board under the work so the cutter won't hit the table as it comes through. The fly-cutter type usually leaves a bevel on the waste, which is ragged at the break-through edge. Therefore if you want a disk, the bit should have an outside bevel, and if a clean hole, an inside bevel. If the stock is thick or you want to avoid edge splintering, go part way and turn over to finish.

Of course the lathe is a natural for making disks. Blanks up to 2″ in diameter can be affixed to a screw center; those up to 4″ can be mounted on a faceplate with one center screw (Fig. 6). Bigger work needs three or more mounting screws. Surface the faceplate side of the blank, and trim it roughly round. To avoid holes in the finished disk, you can glue the blank to a scrap backing block with paper between as shown, and split it off after turning.

Set the tool rest crosswise and just below center height. True the face from the center out with a gouge, finishing with a flat or skew chisel. Touch a pencil to the revolving work to mark the center, and measure from this with a rule to mark the size. On the



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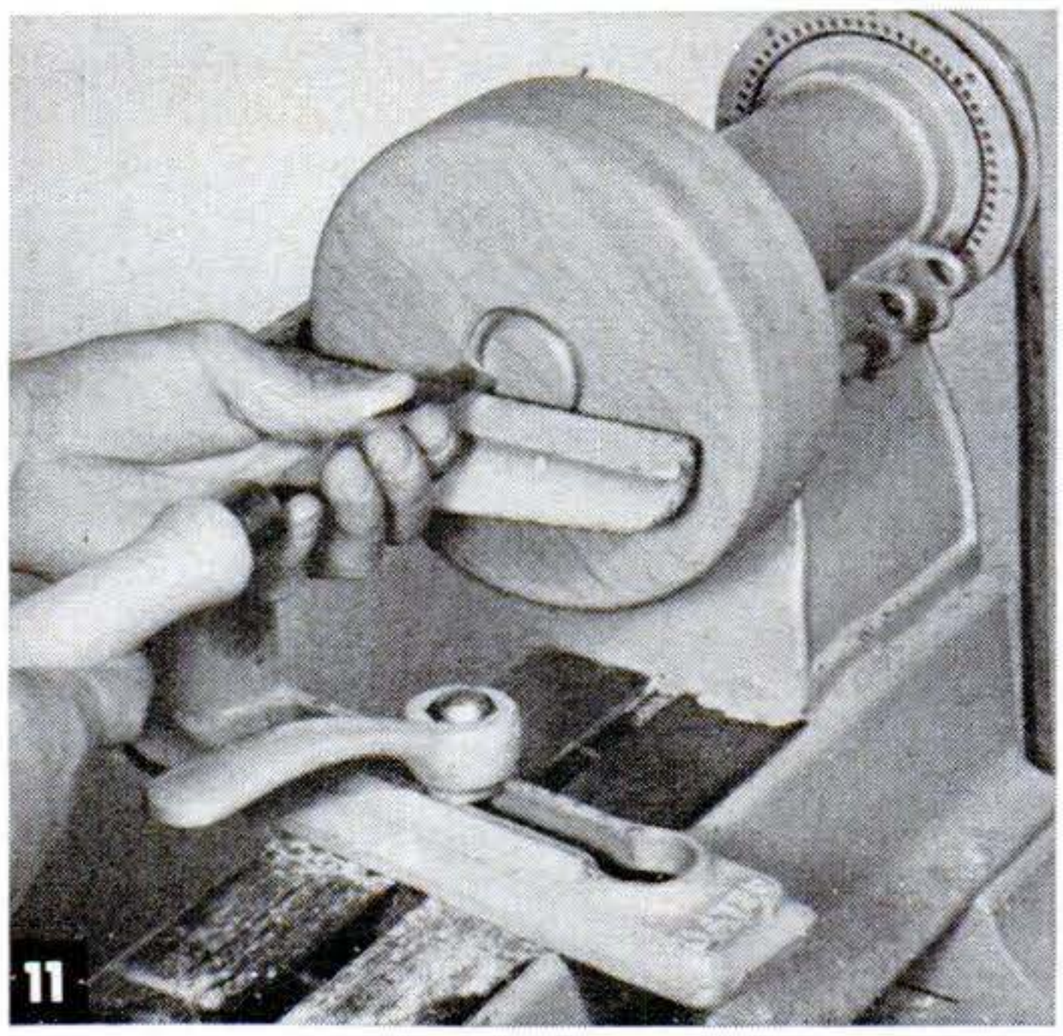

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circle so drawn, run in the point of a skew chisel held flat on the rest (Fig. 7). To avoid splintering the back face, don't cut clear through. Reset the tool rest against the edge, and finish with a flat chisel from the edge. The photo shows a right-angle tool rest that is especially handy for faceplate turning. Sand with a flat backing block under the paper to avoid rounding the edge and corners.

When a lot of disks are wanted, a pad of blanks can be bradded together and mounted between centers for turning. Center holes, if required, can be drilled afterward with the V-jig centered on the drill press.

Small holes are, of course, a job for the drill press. Ordinary auger bits can be used if you cut off the square part of the shank and file the point threads off, preferably to a three-sided point. Left on, they may make the bit seize and yank the work out of control. Set the press for its lowest speed, and before starting, push the bit point into the wood (Fig. 10) to get it started right. Never run an auger bit fast; it may whip itself into a right-angle bend.

Wood bits resembling twist drills, but with spurs and threadless center points (Fig. 9) can be run at moderate speeds. Common twist drills will also serve, but may wander or make oval holes, especially in uneven grain.

Bits can be chucked in the lathe spindle, and the work held against a tailstock pad and fed by the tailstock handwheel. If work is already chucked for turning, or small enough to mount on the faceplate, the bit can be mounted in the tailstock and fed against the revolving work.

Very accurate holes (such as sockets for round tenons) can be bored to size as in Fig. 11. A narrow skew chisel is fed in on a guide line drawn on the face of the disk. Its advance must, of course, be truly parallel to the lathe ways if the hole is to have straight sides. The inside waste is turned away. This may be done faster with a gouge if the hole is large, the shoulder being bored square with a chisel afterward. Be careful not to run the tool into the faceplate or the mounting screws.

Large holes can be bored nearly through. The thin web remaining is easily knocked out after the work is detached from the faceplate, and the narrow flange trimmed flush by hand. When work is affixed to a backing block, the bore can of course be carried right through to the backing. END

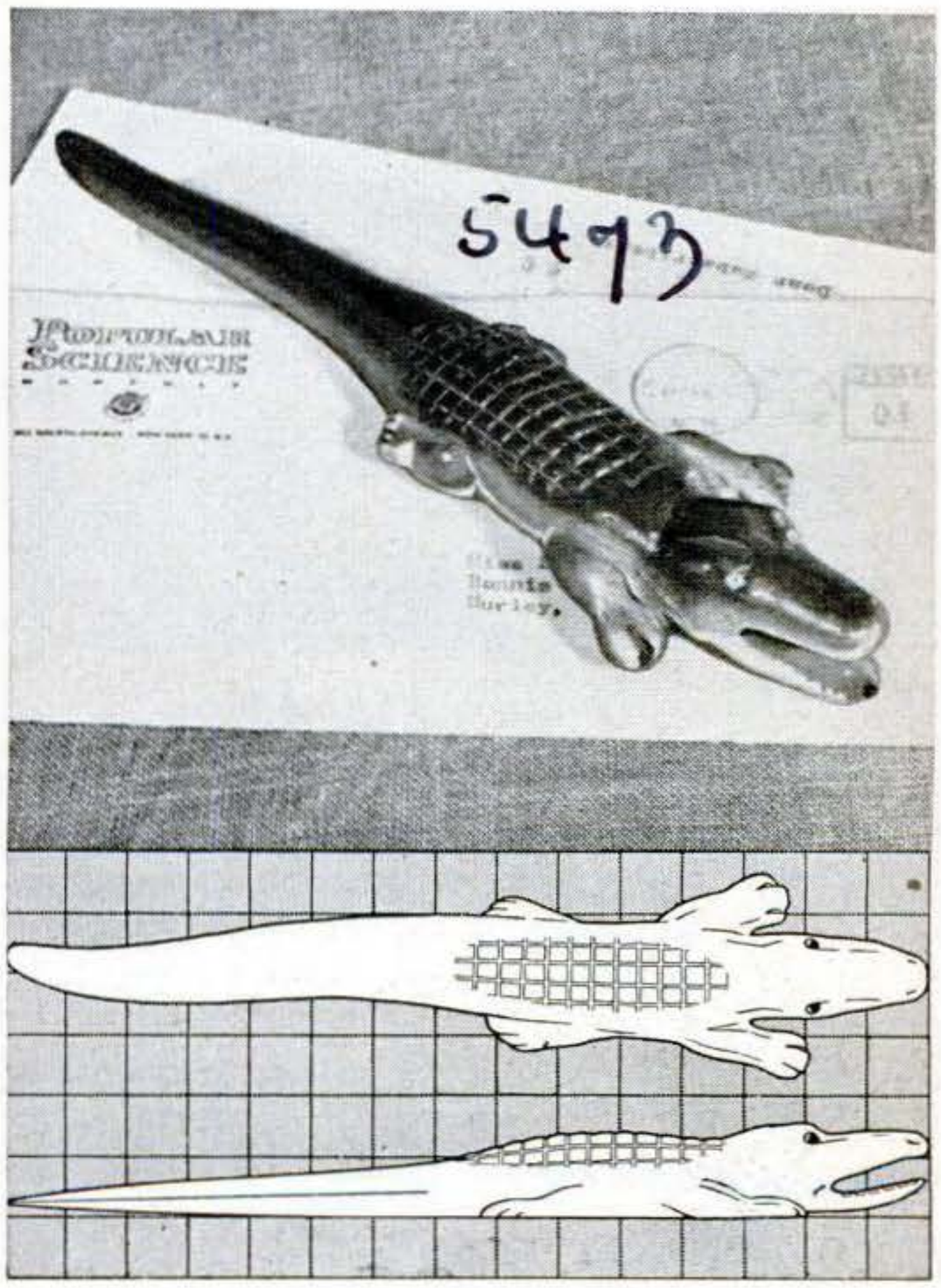
Carved Crocodile Serves as Desk Letter Opener

THERE'S a smile, plus a few evenings of fun, for whittlers in this novel letter opener. The croc's tail is flattened and has sharp edges to slice envelopes open. The body is so shaped that it fits the hand nicely.

Select a straight-grained wood that will both carve well and remain strong in thin sections. Draw a grid of ½" squares on ¾" stock and lay out the pattern by following it on the squares at the right. Saw roughly to the shape of the top view. If you have a bandsaw, you can save time by tacking back the waste and sawing to the side profile also.

Carve the body, head, and legs to a well-rounded form, but make the tail quite thin. For the hide markings on the back, carve shallow grooves both lengthwise and crosswise.

Sand smooth without obscuring detail. Paint the top of the body brown, letting this shade into cream at the sides and using cream for the underbody. The inside of the mouth is red, with white teeth. For eyes paint white dots with tiny black pupils.—*Elma Waltner, Hurley, S. Dak.*



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NEW TOOLS

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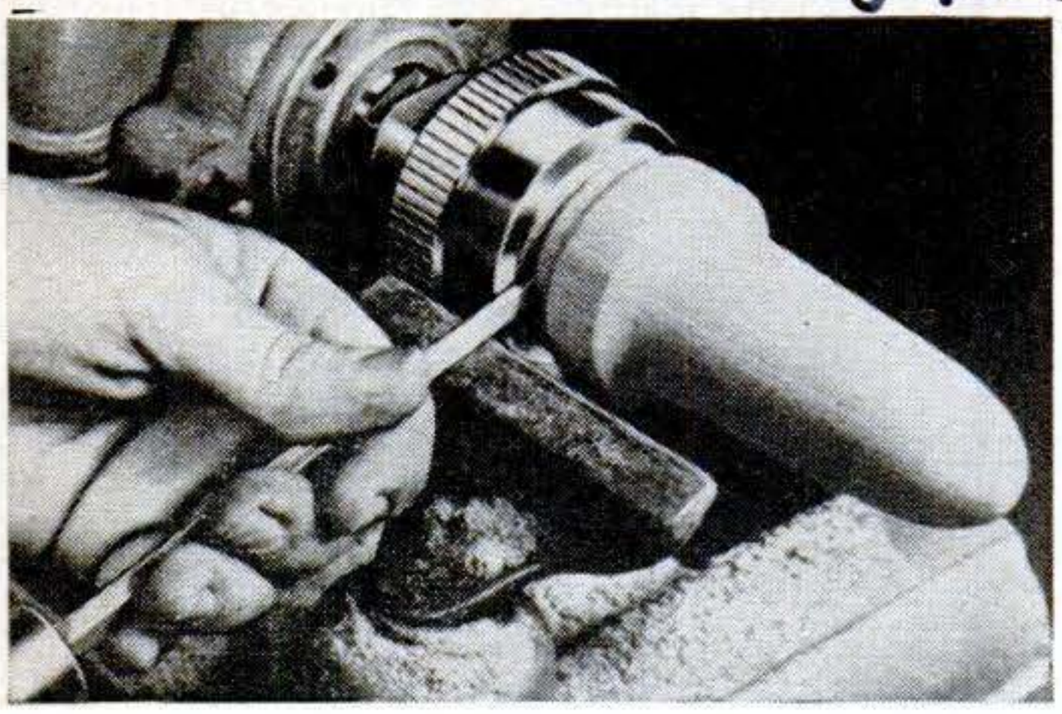
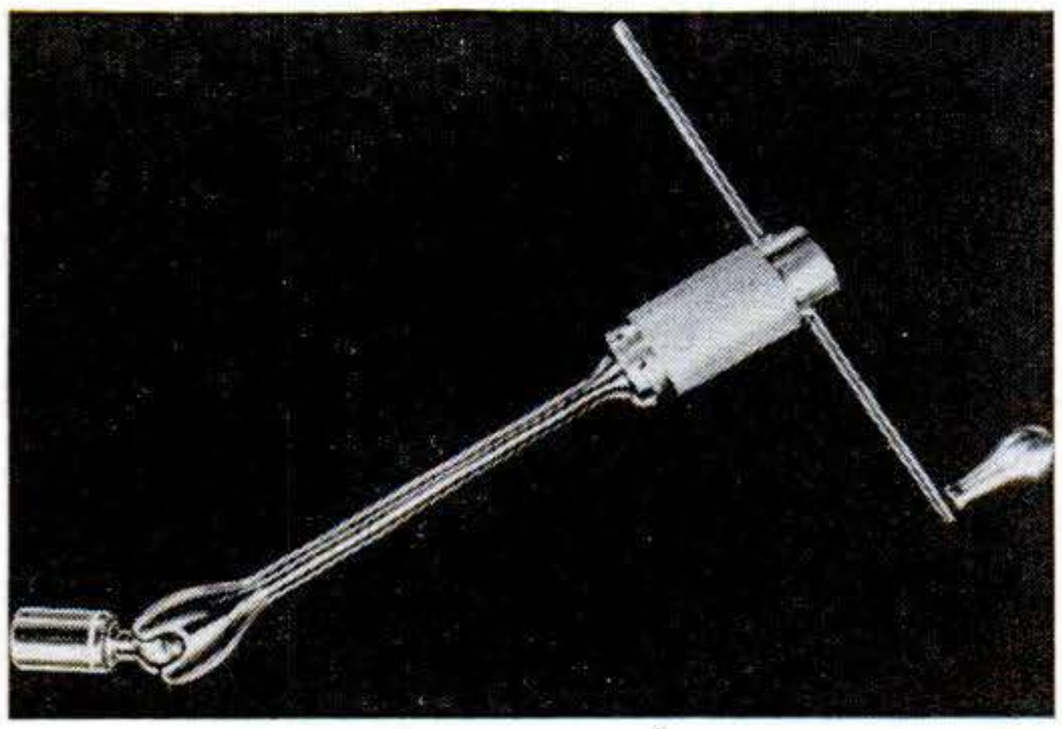


Collet Chuck Features Safety

DESIGNED for use on lathes with a 1"-8 spindle thread, this new collet chuck has no projections to catch clothing or fingers or to damage tools. Work can be done from any angle and right up against the chuck without danger.

Fully balanced for accuracy at high speeds, the chuck has a work capacity ranging from ½" to 2". Taking any of three double-end collets, it can be tightened or loosened with a twist of the wrist. It's a product of Delta Manufacturing Division of Rockwell Manufacturing Co., Milwaukee, Wis. The chuck weighs 2½ lb.



Handle Gets into Tight Spots

A BALL-AND-SOCKET universal in this new ratchet handle has spring tension to keep the socket in any desired position. For rigid use, it can be angled to as much as 90 deg. A thumb control shifts the ratchet. A knob on the end of the adjustable crossbar makes it easy to use the tool as a speed wrench. The Browning Tool Co., Bozeman, Mont., makes it in various sizes. Prices range from about $18 to $23.

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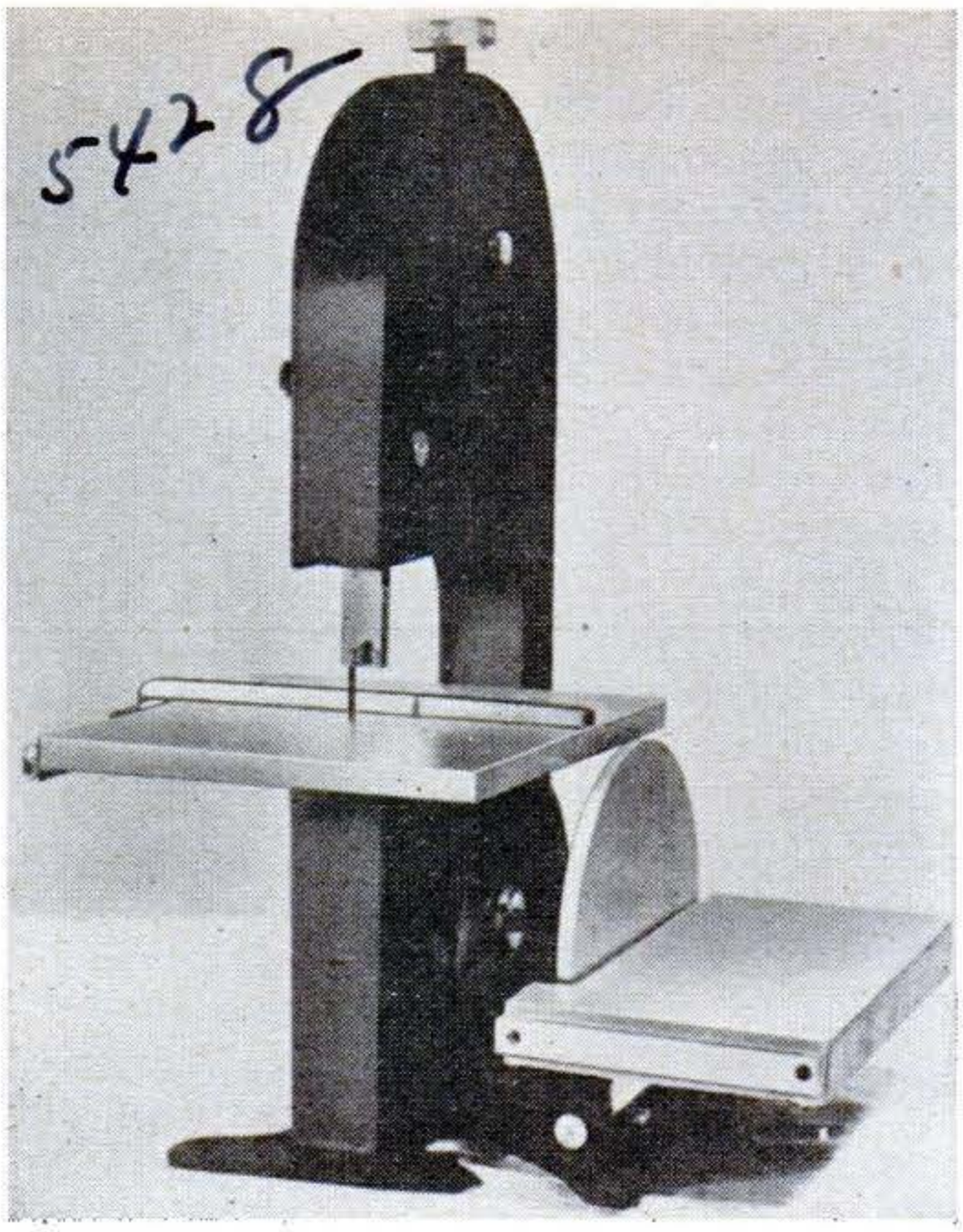
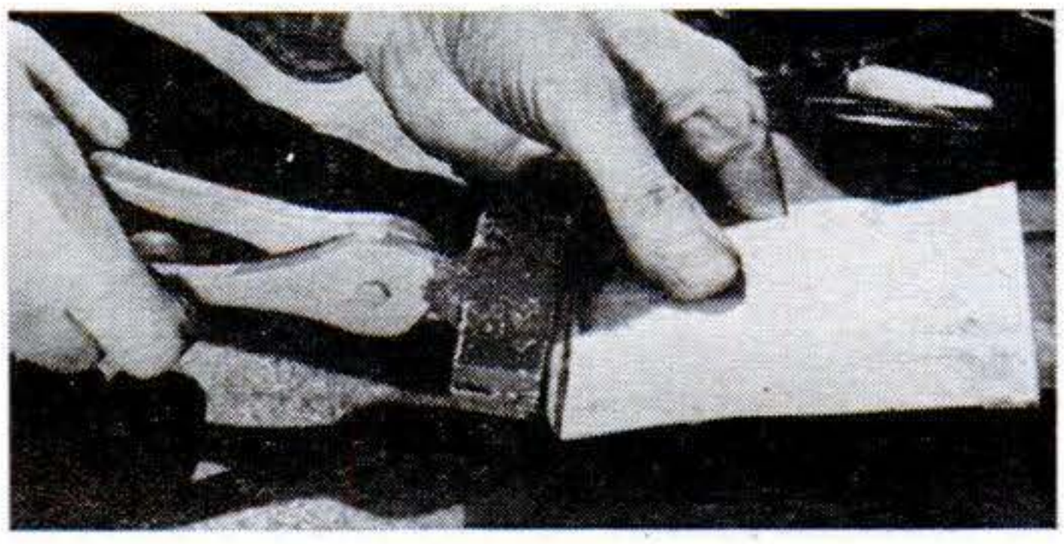


Bandsaw and Sander Combined

HERE are two popular power tools in one unit. The bandsaw handles stock up to 2½" thick, cutting to the center of a 14" circle. A 9" sanding disk is mounted on the end of the drive shaft. The sanding table is adjustable.

Manufactured by Radius Precision Tools, of St. Louis, Mo., the combination tool operates on either a ¼-hp. or 1/6-hp. motor. It uses a standard V-belt drive.



Pliers Bend Sheet Metal

WIDE-NOSED pliers now being offered to sheet-metal craftsmen simplify the forming of channels and other kinds of bends, especially in smaller sheets.

Made by the Vise Brake Manufacturing Co., of Omaha, Neb., the pliers may be obtained with jaws either 2½" or 3" wide. One of the jaws is square along the front edge. The other is beveled to facilitate sharp bending beyond 90 deg.

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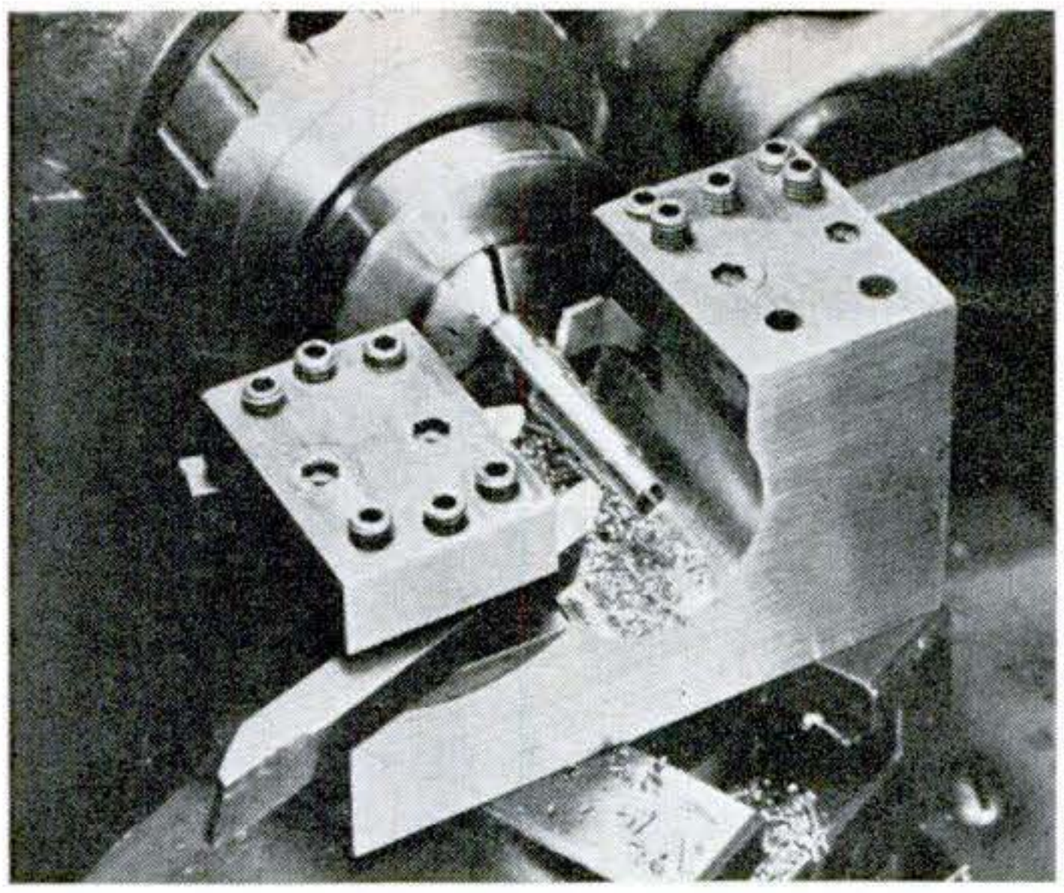
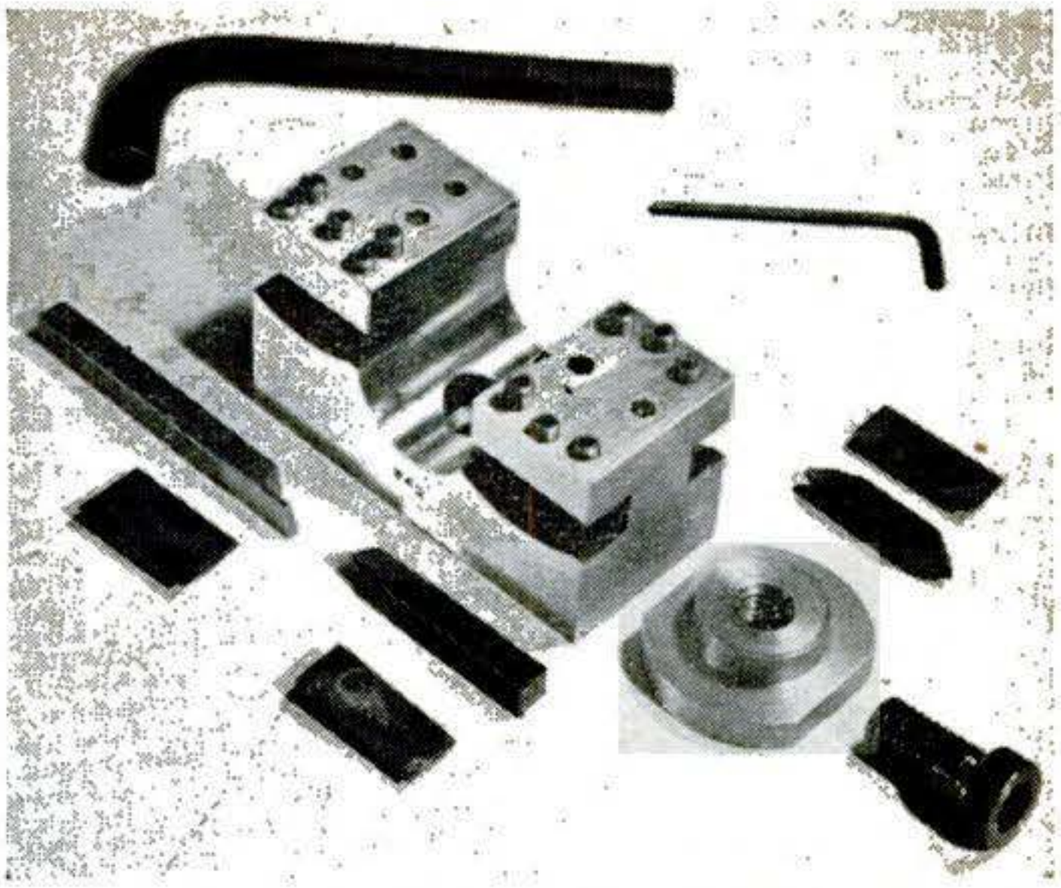


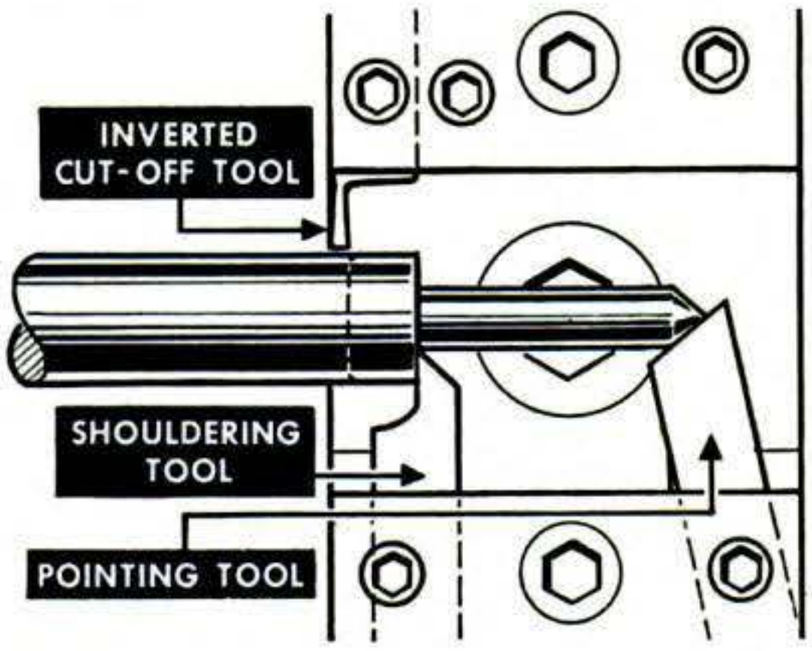
A cut-off tool is inverted in the rear slot. Rockers permit vertical adjustment of tools.



A turned nut and hollow-head bolt clamp the holder to the T-slot of the compound rest.

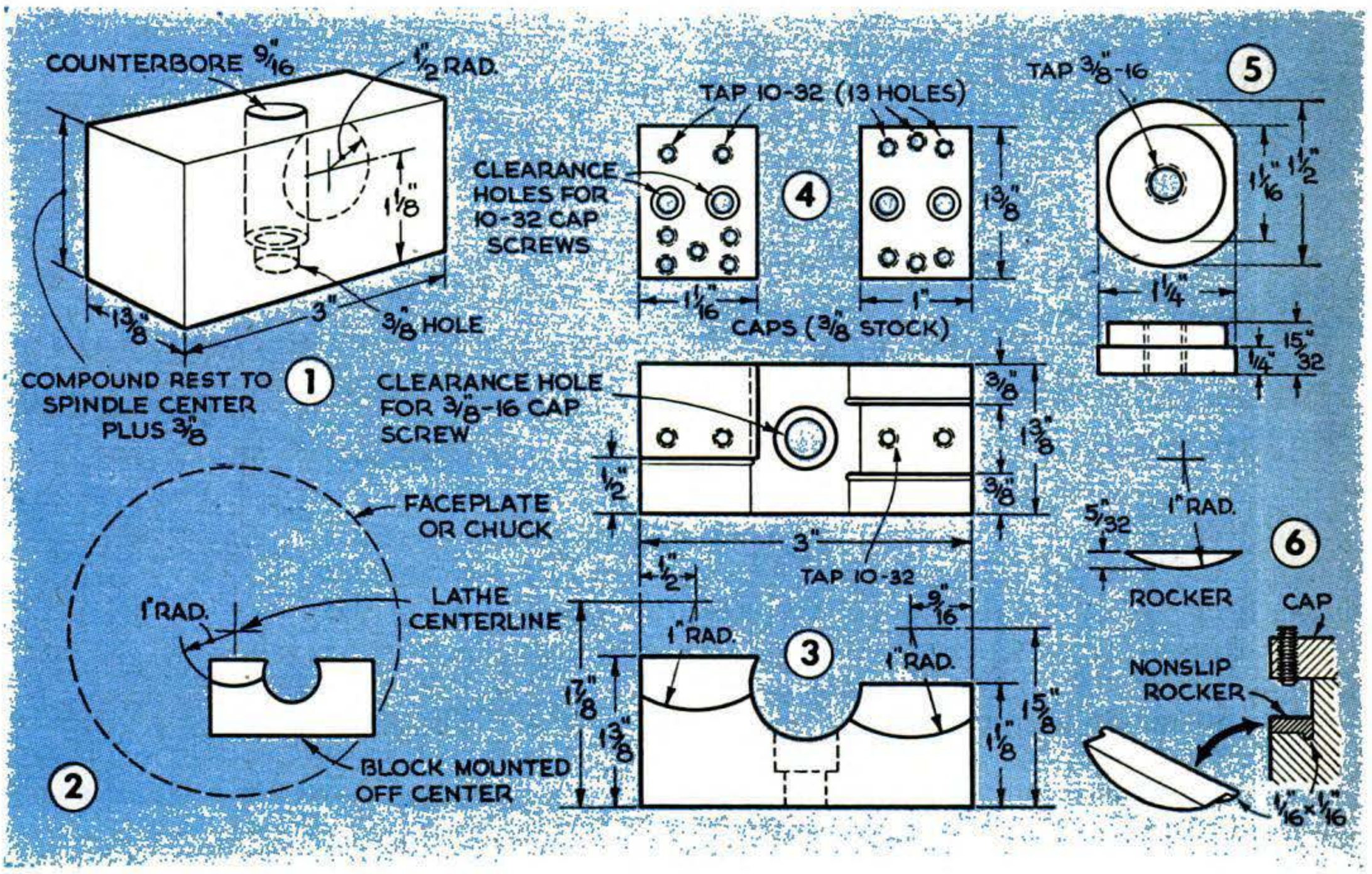
7001

Three-Tool Holder Turns Small Parts Fast



WHEN you have to turn a lot of identical small parts, this box-type tool holder does a perfect job. It easily handles work up to ½″ in diameter. Special screws and pins, duplicate parts for models, rivets, and small gear blanks are some of the possibilities. The sketch at left shows one setup.

Dimensions given below are suitable for a 9″ or 10″ lathe. Begin by squaring up a block of tool or cold-rolled steel to measure 1⅜″ wide and 3″ long. Make the height equal to the distance from the compound-



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rest top to the centerline of the lathe spindle, plus about ⅜″ (Fig. 1).

Through the center, drill vertically a ⅜″ hole and counterbore it to within ¼″ of the bottom to clear the head of a ⅜″-16 hollow-head cap screw. Next turn a stepped nut to fit the tool-post slot (Fig. 5).

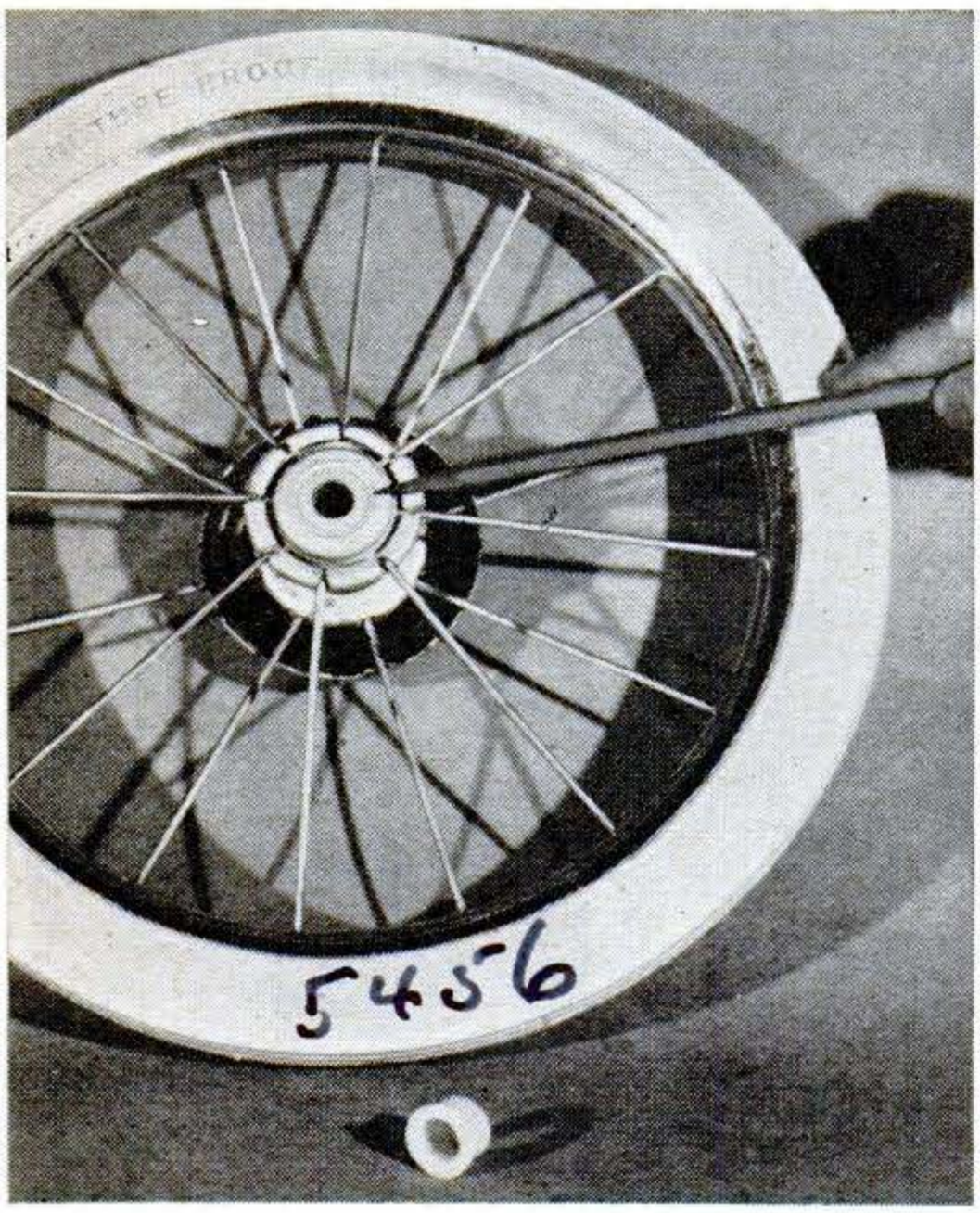
With this nut and a ⅜″ screw, clamp the block to the compound with the longest dimension at right angles to the lathe ways. Center a 3/16″ bit 1⅛″ from the bottom edge of the block and drill a pilot hole. Then enlarge this to 1″ (Fig. 1).

To machine the round-bottomed notches, mount the block off center on a faceplate or in an independent-jaw chuck (Fig. 2). For the rear one, locate it with the lathe centerline 1⅞″ from the bottom of the block and ½″ from the end; for the two front notches, 1⅝″ and 9/16″ (Fig. 3). Use the micrometer collar on the cross-slide screw to determine the 1″ radius.

Machine the rear recess ½″ wide, the front ones ⅜″. If you wish to use rockers that won't slip outward, make a 1/16″ by 1/16″ recess in each notch (Fig. 6). Reduce the rear height of the block to 1⅜″, the front to 1⅛″ (Fig. 3).

Drill and tap the block for the four 10-32 cap screws that retain the two caps (Fig. 4). In the caps, drill and tap the indicated number of holes for 10-32 setscrews ½″ long. Stagger these as shown so bits may be clamped at various angles. The two extra holes in the rear cap are handy for holding a coolant hose, adjustable stop, or lens.

For plain rockers, turn a blank of ½″ hardenable steel to 2″. Saw off a 5/32″ segment for the rear rocker. Then reduce the blank thickness to ⅜″ and saw off the front two. For rockers with a retaining lip, start with a 2⅛″ blank. The top surfaces may be serrated.—*Walter E. Burton and W. A. Conway, Akron, Ohio.*



Wheels Roll on Nylon Bearings

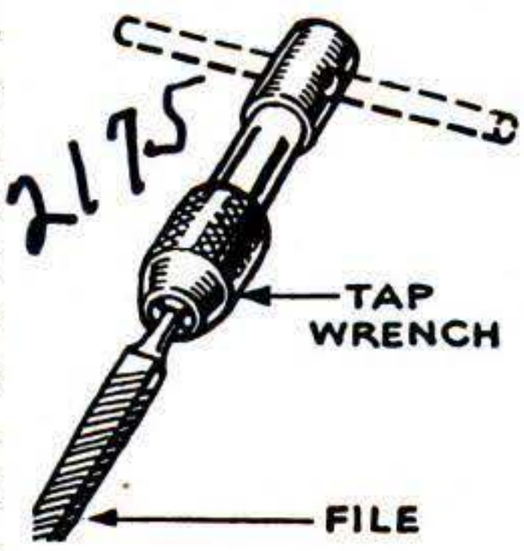
Bearings made of Du Pont nylon plastic are used in the wheels of baby carriages manufactured by the Collier-Keyworth Co., of Gardner, Mass. In one test, a carriage wheel was turned for the equivalent of 1,190 miles. Bearing wear was negligible.

Other nylon bearing applications are being tested. It has been found that these need no lubricants for light loads at high speeds or moderate loads at low speeds.

Assorted Tubing in One Pack

Here's a new item to fill out the craftsman's stock of handy materials—a package of assorted steel tubing ranging from ⅜″ to 1¼″ o.d. in ⅛″ steps. Each piece is 12″ long, but greater lengths are available if desired. Packaged by the Towers Corporation, of Cleveland, Ohio, the kits sell for $2.50 each. The tubing is low-carbon cold-rolled steel of 18-gauge.

Wrench Serves as File Handle



While out on a recent job I found my file handle had been left behind. Spotting a T-handled tap wrench in my kit, I placed the tang of the file in the adjustable jaws, tightened them up, and slipped out the cross-bar. I've used this stunt many times since, often leaving in the bar for a better grip.—*Robert E. Rusch, St. Albans, N. Y.*

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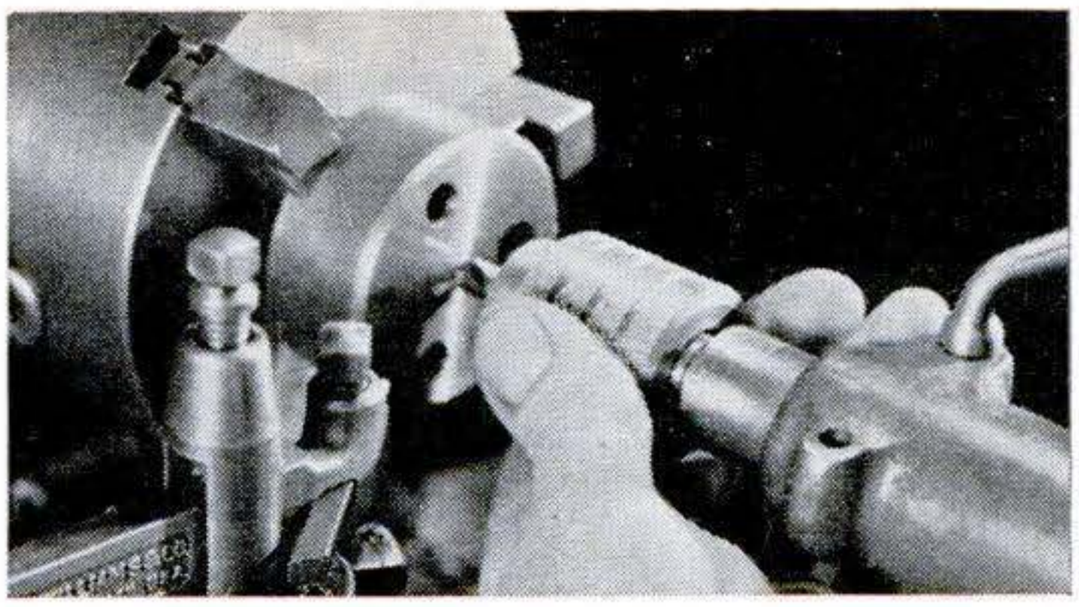
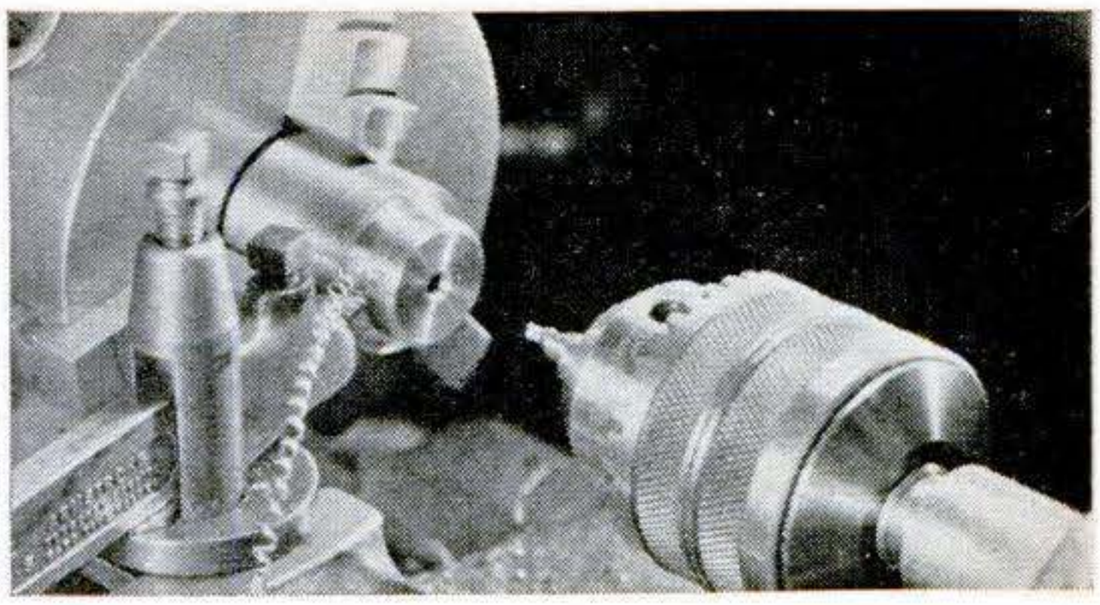
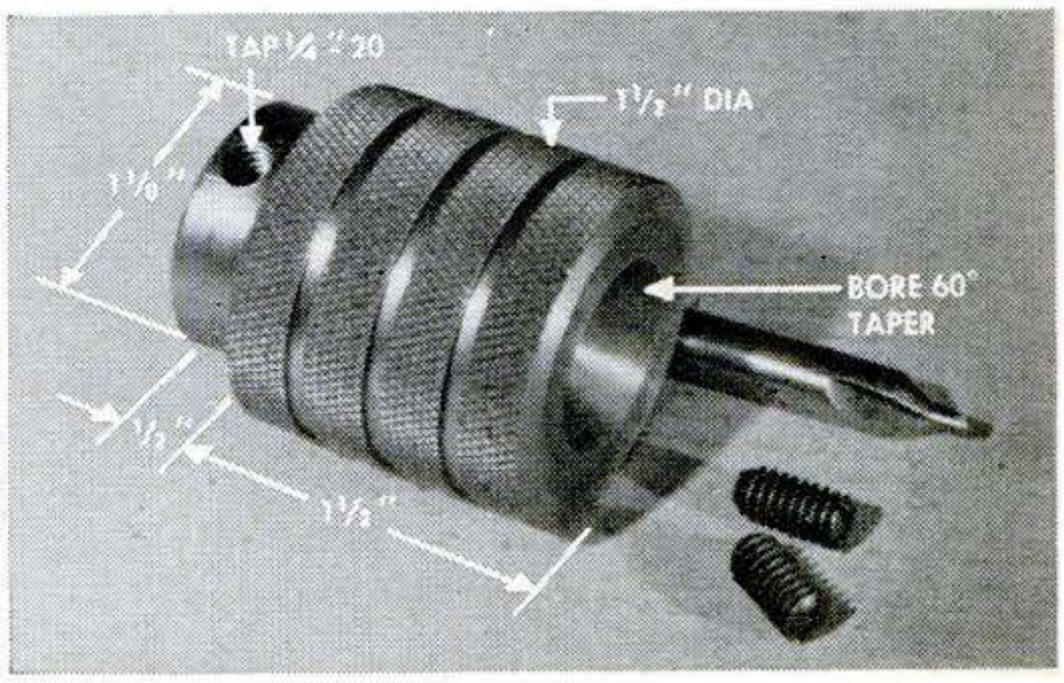


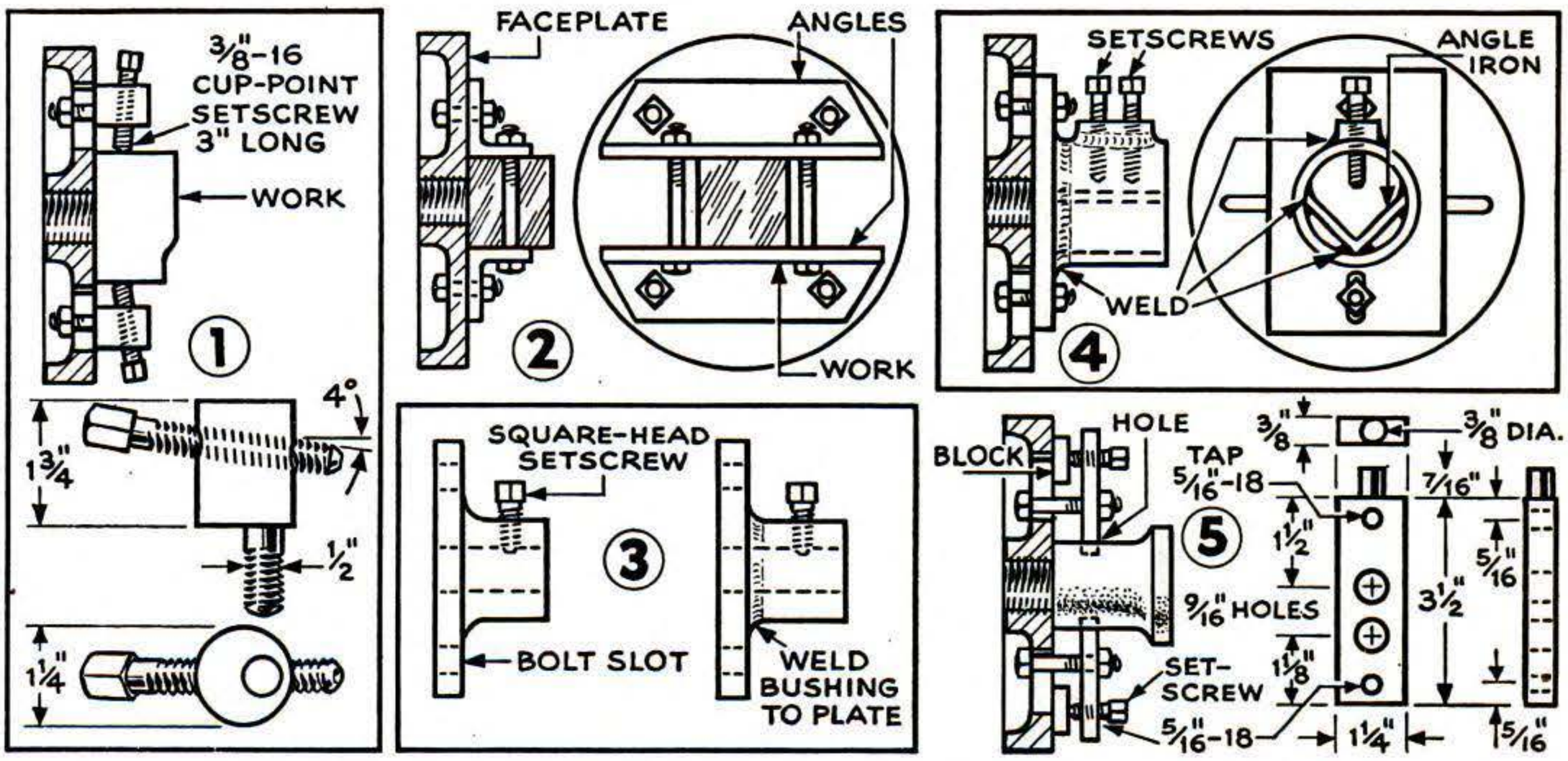


Simple Hand Chuck Stops Centerdrill Breakage

Tip breakage of centerdrills is less likely with this little hand-held chuck, because if the going gets tough, the chuck will simply turn between your fingers. It's a big time-saver too; the centerdrill can be kept in the chuck, which is merely slipped over the tailstock center whenever you wish to use it.

Turned from a short length of cold-rolled round stock, the blank is first chucked as at right above and turned and drilled. Reversed in the chuck, it is given tailstock support while it is knurled and grooved. Then the tailstock is backed off and the 60-deg. taper hole is bored by a series of light cuts with the compound set at the proper angle. Holes for the two hardened setscrews are drilled and tapped 90 deg. apart.—*C. W. Woodson, East Aurora, N. Y.*





Faceplate Setups Substitute for Four-Jaw Chuck

If you don't have a big four-jaw chuck, you can still handle good-sized castings and irregular pieces. The setscrew studs in Fig. 1, for instance, work nicely on a faceplate. Two steel angles will hold square or rectangular pieces (Fig. 2).

Figures 3 and 4 show devices useful in production runs. The first is used mainly with round stock of fixed size; the one in Fig. 4 takes different diameters. Both can be mounted off center for eccentric work. True up the faces that meet the faceplate with the fixtures mounted backward on a stub arbor.

With castings that permit drilling, the faceplate straps shown in Fig. 5 are good, since the work faces produced are certain to be parallel.—*J. A. Blaker, Auburn, Mass.*

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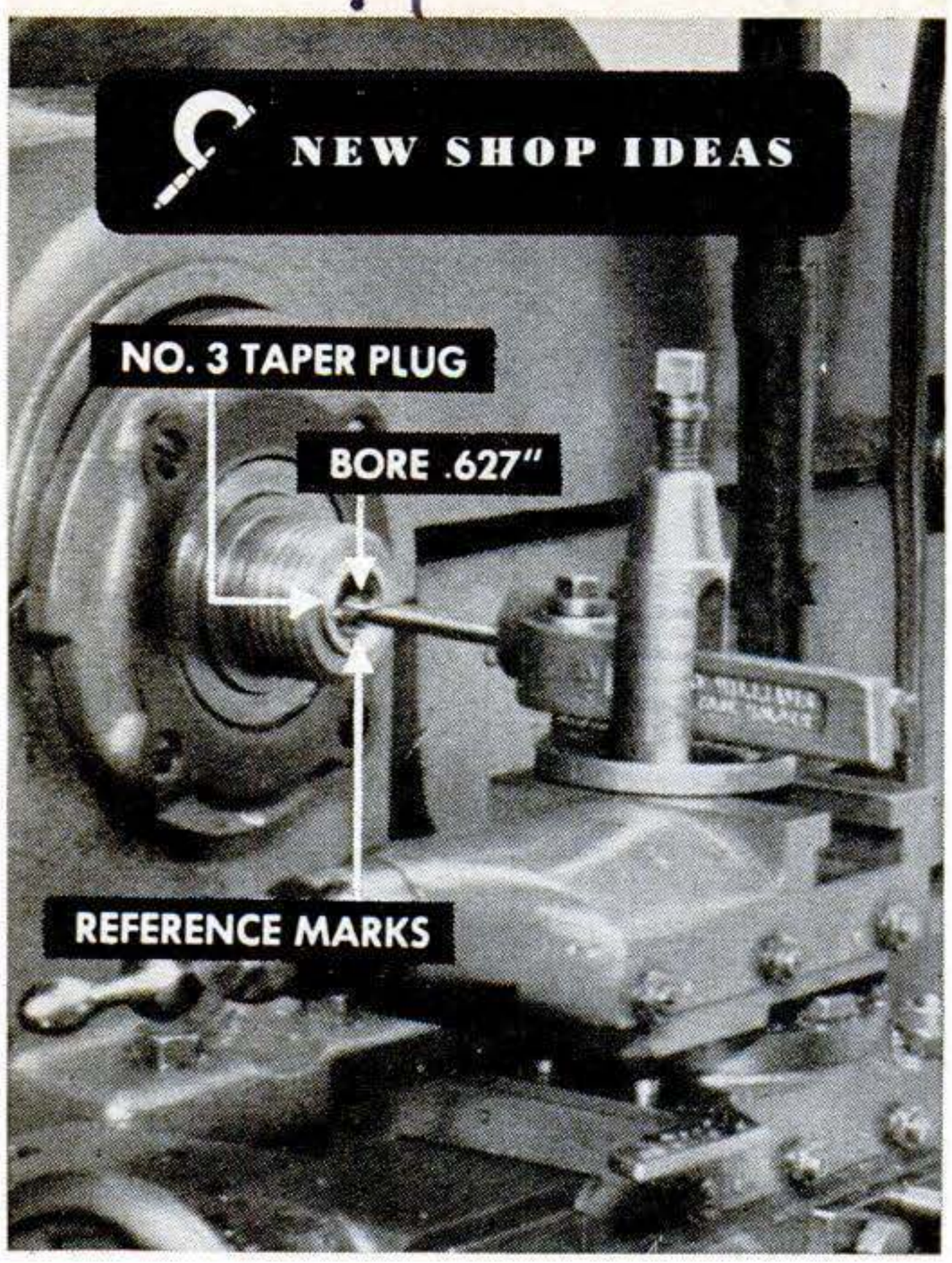
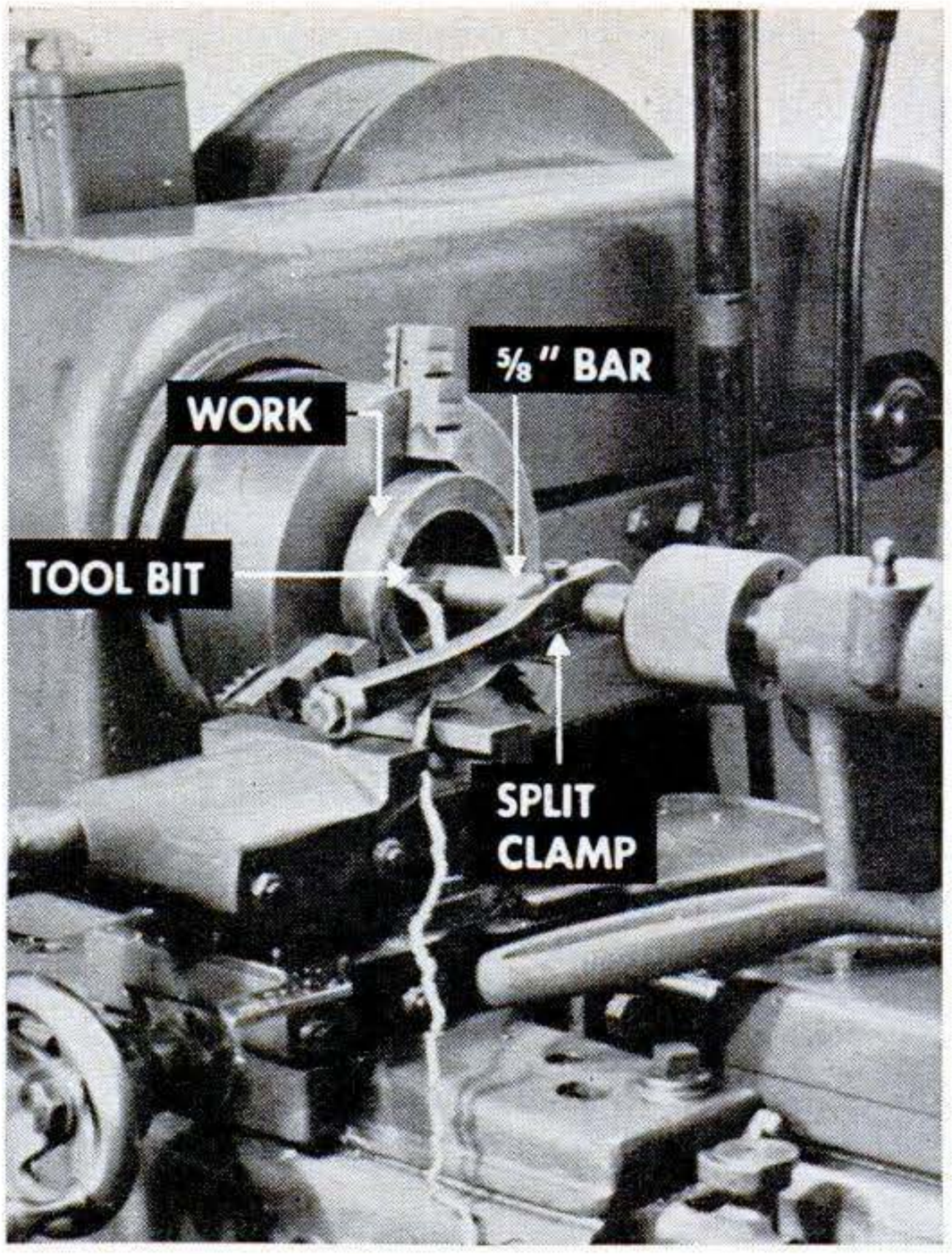
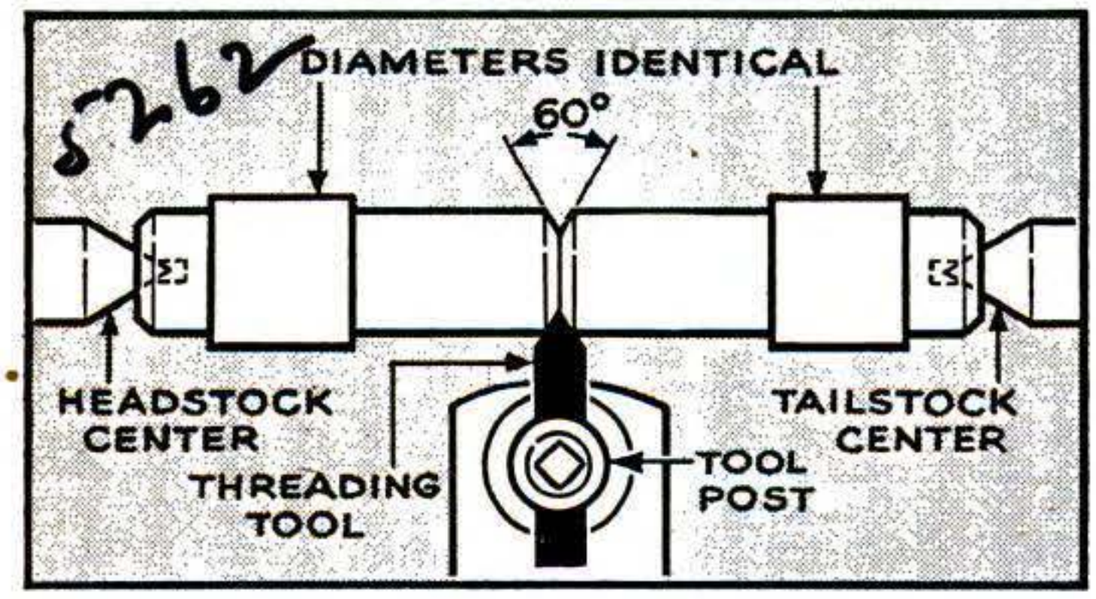




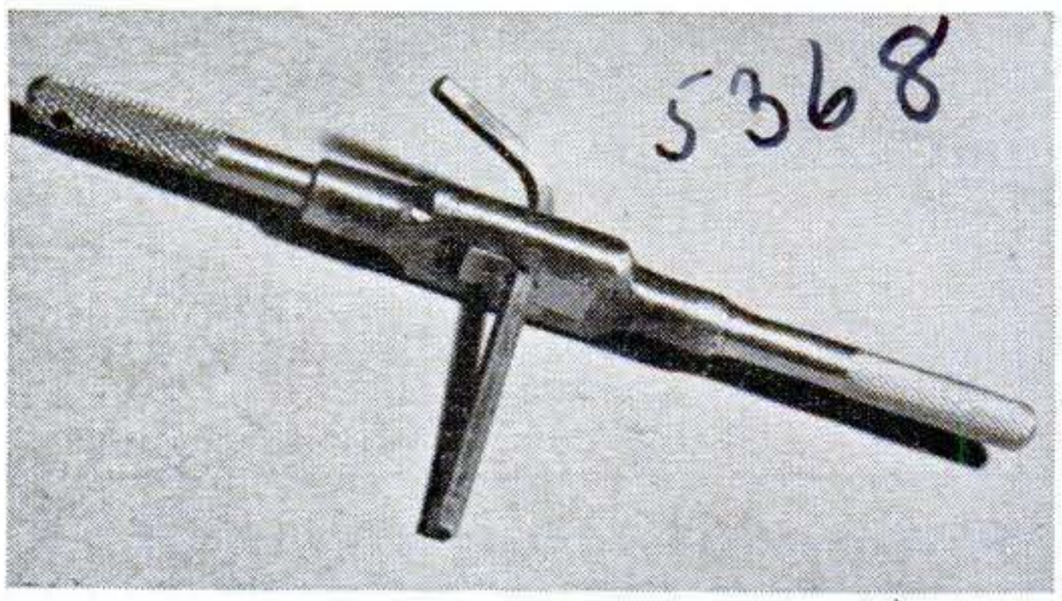
Bar Bores Big Holes. Firmly held at both ends, this stationary boring bar makes through holes of any size between ¾" and 3". On a 10" lathe I've taken ⅜" at a pass. It works faster than a big drill.

A plug turned to fit the spindle taper is driven in, with punch marks to insure that it can always be reinserted the same way. It is bored out .627", as at left above, to a running fit for a ⅝" bar. One end of the bar is rounded; the other has a center hole. Midway of the bar is a 3/16" square hole for the bit, which is held by a transverse setscrew.

One end of a flat bar is bored ⅝", split, and fitted with a clamping screw. On the other end I've mounted a ball bearing to roll along the compound rest, as shown at right above. However, this can be dispensed with. In use, the bar and plug are suitably lubricated, and work is mounted with clearance behind. Thus the spindle and work turn (I use the slowest direct drive) while the stationary bar is supported by the plug and fed into the work by the tailstock ram. Tool bits should have correct boring angles.—*August Dobert, Nashville, Tenn.*



Setting Threading Tools. This lathe help makes quick work of setting a threading tool dead square or, with an indicator, aligning the tailstock. On a ¾" by 8" bar, turn identical diameters and form a 60-deg. groove by feeding in at 30. deg. from each side. Set thread tools in the groove.—*Theodore Kanakos, Bronx, N. Y.*



Tap Wrench Puts Twist On. Sometimes setscrews can't be reached by the short end of a hex wrench, and with the long end in the screw socket, there isn't enough tightening leverage. A tap wrench gives you the necessary length and also plenty of torque for tightening. Take care not to strip threads.—*J. M. Avery, Delhi, N. Y.*

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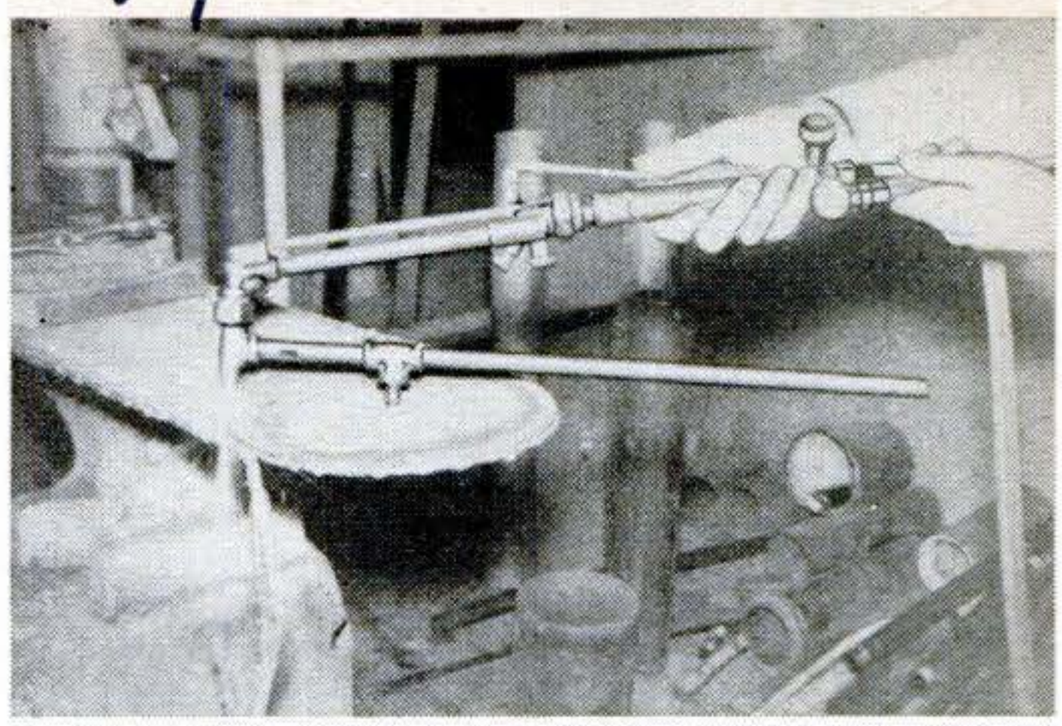
5299

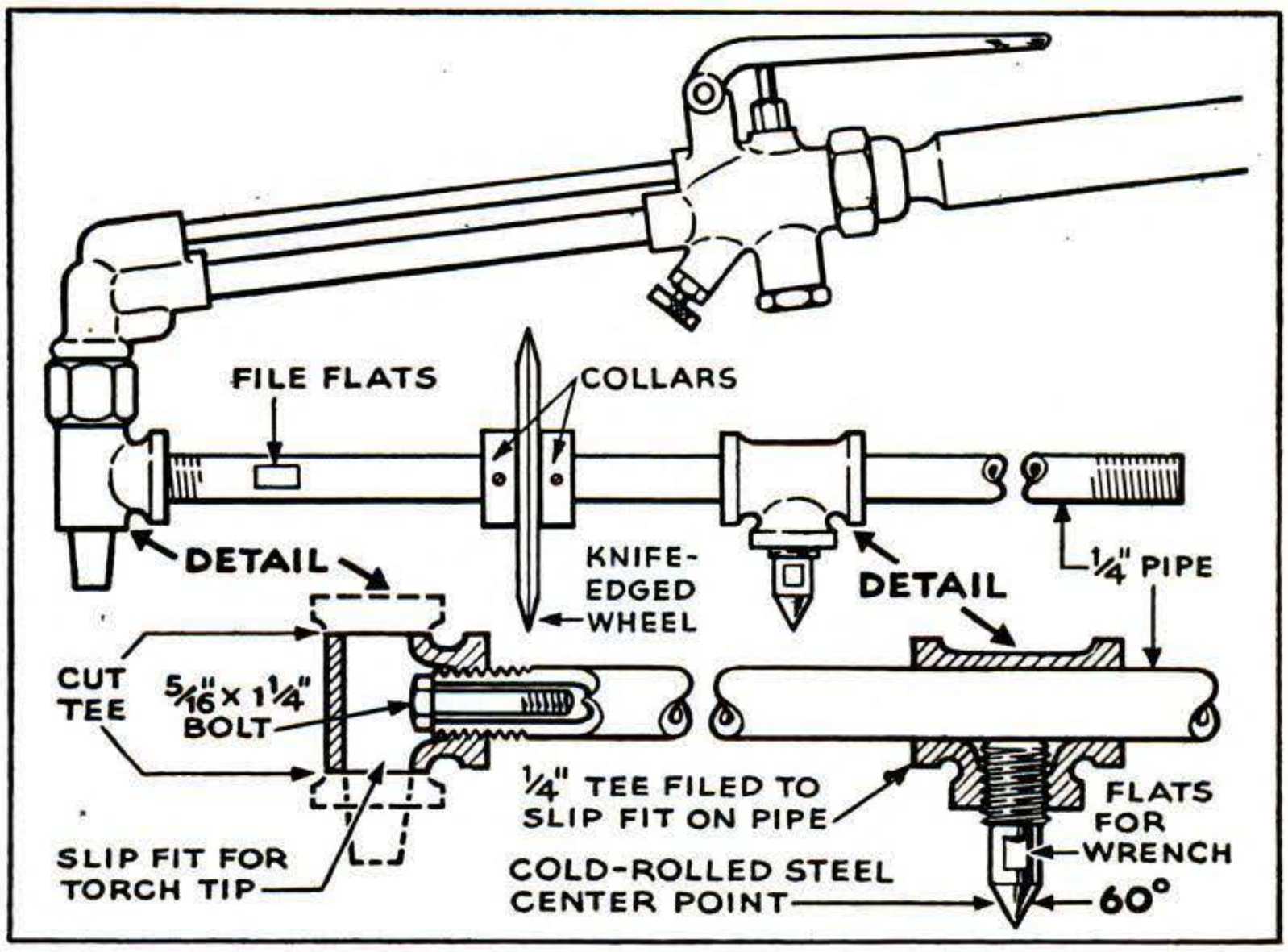
Cutting Disks with Torch. True holes and disks are cut with an oxy-acetylene torch mounted on this guide. I've found it better than a chalk line or a solid pattern.

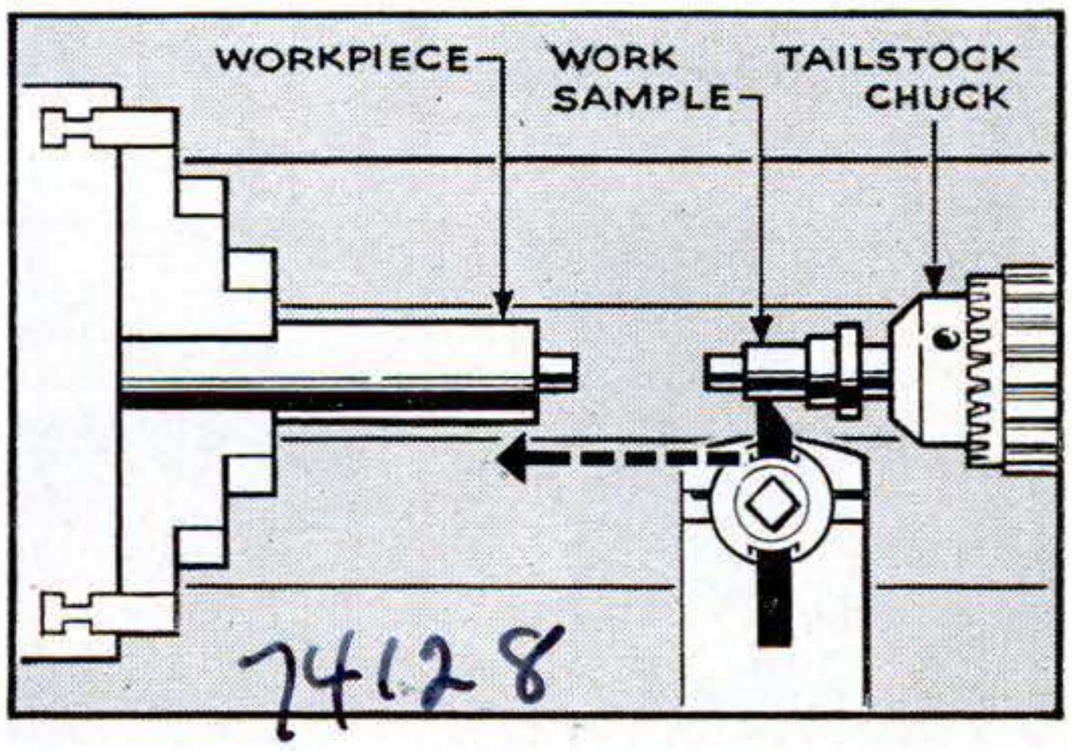
Cut extra-long threads on an 18″ length of ¼″ pipe. Saw and file out a pipe tee as shown, file the head of a bolt slightly concave to fit the torch tip, insert it in the pipe, and screw on the tee. Turning the pipe should clamp the torch tip fast.

File another tee to a sliding fit on the pipe. Thread a bit of ½″ rod to fit it, cut to 1¼″, turn a point, and file two wrench flats. Tightening on these locks the tee. Turn a knife-edged disk to a diameter that brings the edge even with the pivot point, and secure it with two collars so as to turn on the pipe.

The point should rest in a punch mark. Practice will show where to start the cut so as to swing without interfering with the hoses. — *Carl Tretin, Austin, Minn.*







74128

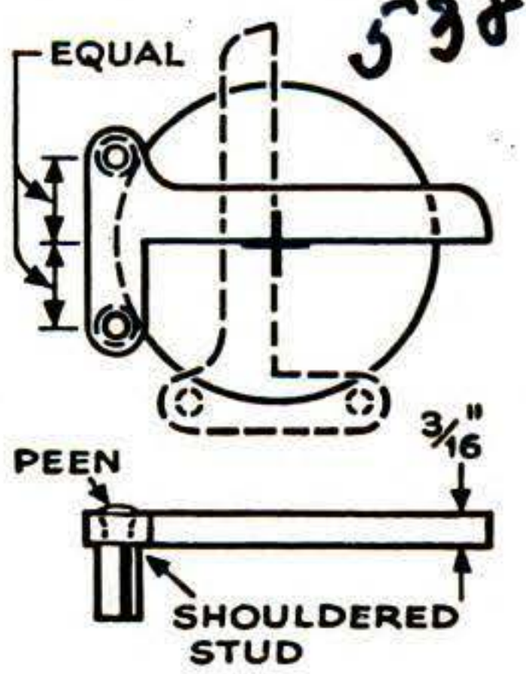
Sample Speeds Duplication. Having to duplicate a number of short turnings, I chucked the originals in the tailstock. Running the bit up against the different diameters gave me cross-feed settings within about .005″, so I had only to run the carriage over to turn the work to the same diameters. On jobs that don't call for close tolerances, the method saves a lot of time and trouble.—*H. L. Pfister, Bronx, N. Y.*

5337

Paste Holds Welding Work. Small parts are often hard to hold in place for welding. One way to secure them is to mix a stiff paste of powdered asbestos and water, and insert the pieces in position, leaving the portion to be welded exposed.

Square Finds Centers. Pocket-size and accurate, this center square is made of flat steel and drill rod. Lay out the tongue exactly midway between the studs and at 90 deg. to their centerline. Take care to turn truly concentric shoulders on the studs. As with other finders, intersection of lines about 90 deg. apart is the center.—*Federico Strasser, Santiago, Chile.*

5387



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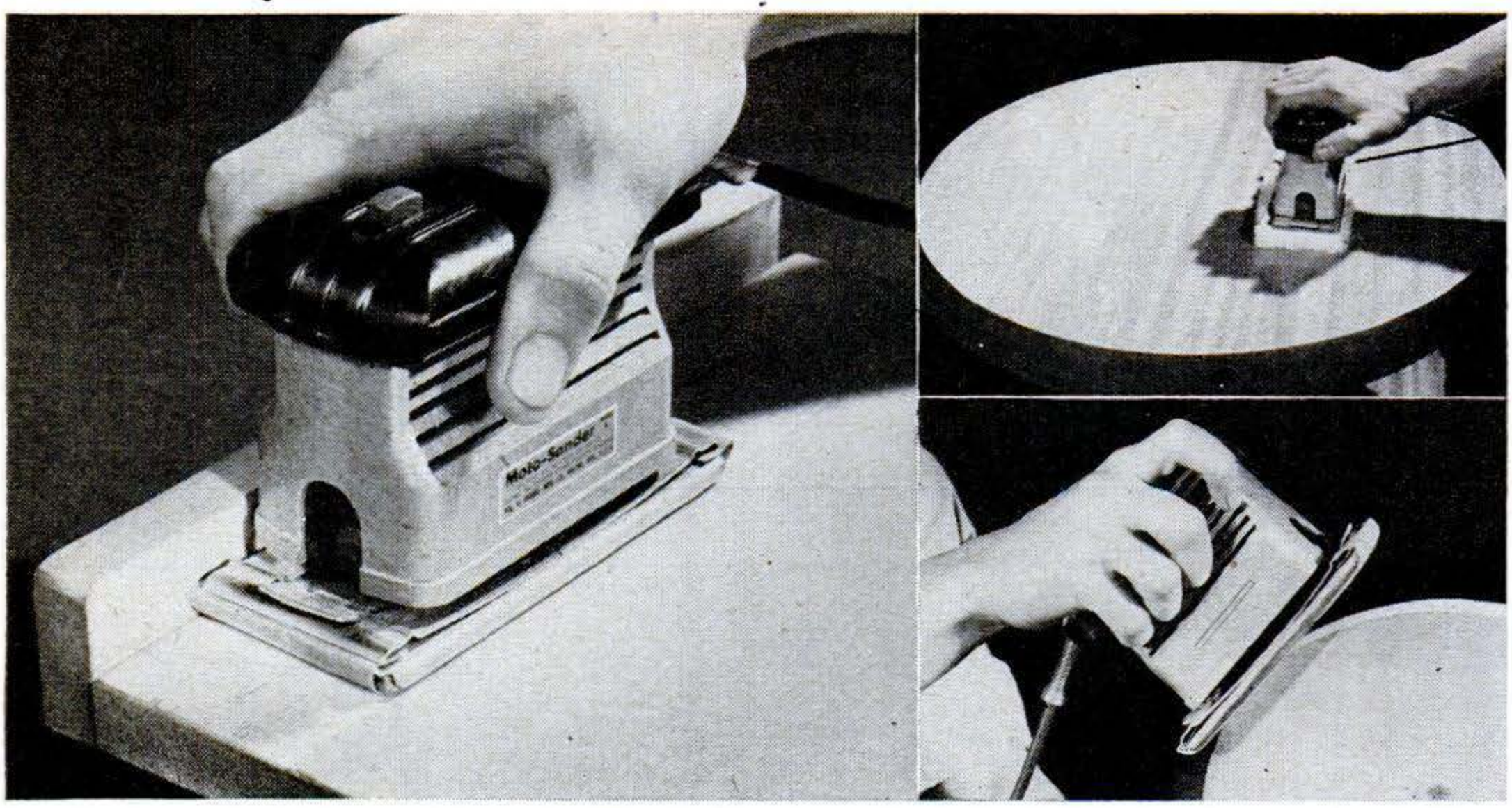


Vibrating Sander Also Does Waxing and Polishing

SHOP tests by PS editors of a new small electromagnetic sander reveal that such tools may find uses in both the workshop and home.

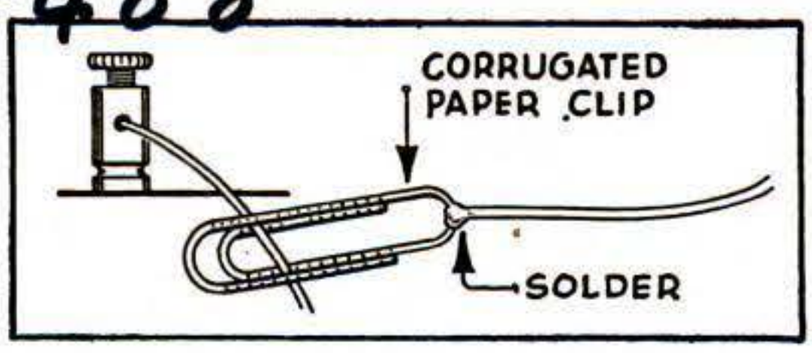
Though not suited for heavy cutting or large areas, they seem well adapted to the medium- and fine-grit work important to good finishing. The rectangular 2¼" by 5½" pad reaches close-in areas difficult to work with rotary sanders. The tool shown is light (2½ lb.) and quiet. It runs on AC only.

Sandpaper may be quickly replaced with a waxing pad or sheepskin polisher for polishing furniture or autos. The tool above is made by the Dremel Mfg. Co., Racine, Wis., and retails for around $15.

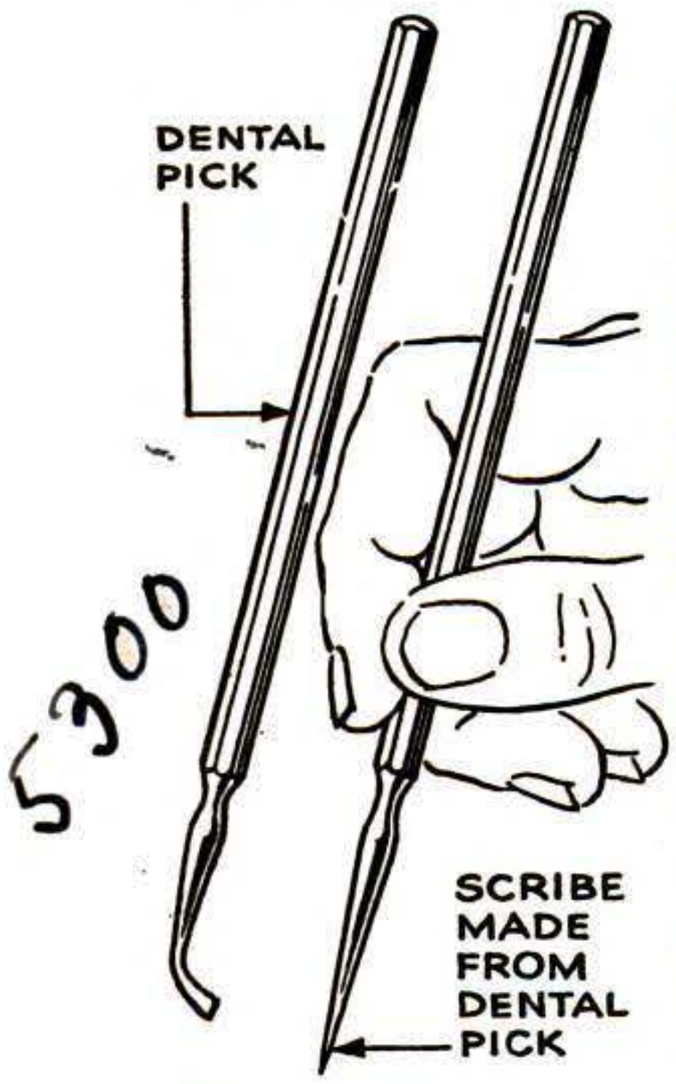
Paper Clips Make Test Connections

5408

ELECTRICAL circuits under test or construction often call for temporary, quick-change connections. In much "breadboarded" work, the clip connector shown at right is handy. Numerous leads may run to one paper clip.



Dental Tool Is Good Scriber



5300

OLD dental picks, sharpened on a fine emery wheel, make excellent metal scribers. Offset picks may be left bent for use in close quarters, or heated cherry red, forged straight, and hardened and tempered. Draw to a straw color to prevent breakage in use. In grinding picks, take care not to overheat and soften. Use corks on the ends. — *Carl Tretin, Austin, Minn.*

5055

Old Oil Can Is Shop Drawer

EMPTY 10-qt. or 2-gal. rectangular oil cans may be cut down to form serviceable workbench drawers. Remove one side, cut each corner down to the desired drawer depth, and fold over the cut edges to form a safe edge all around.—*Gordon J. Skinner, Rochester, N. Y.*

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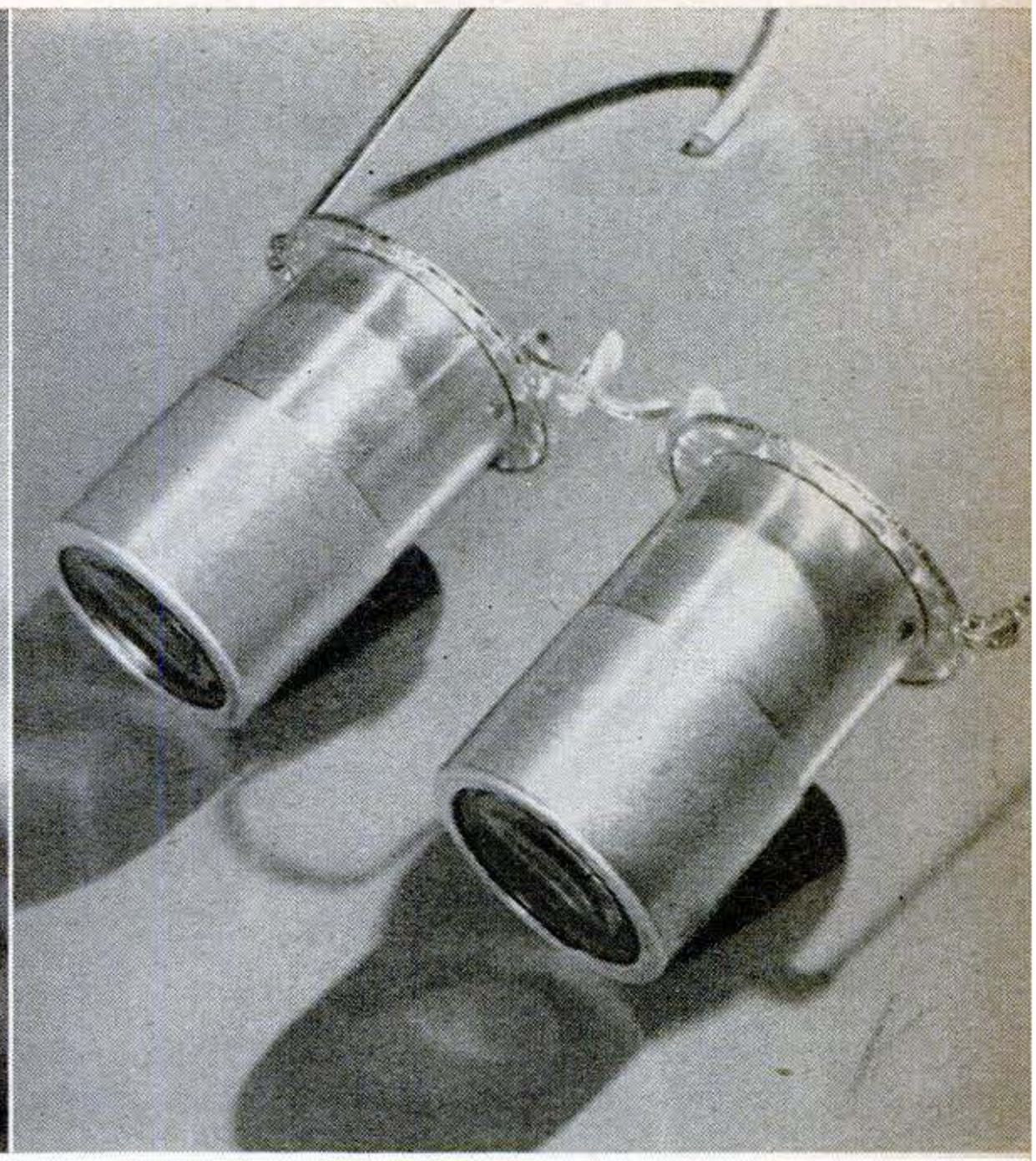


Clear-cut images from 6′ to infinity are produced by these glasses with only simple lenses.

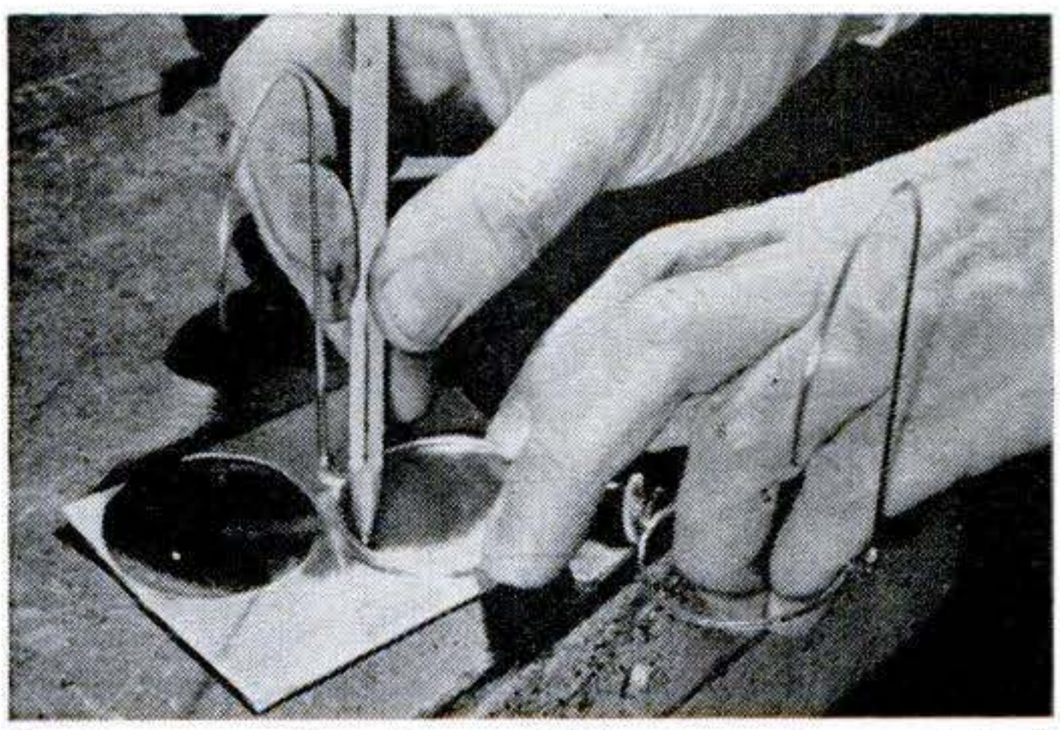
Telescopic Glasses Give You a Front-Row Seat

3250

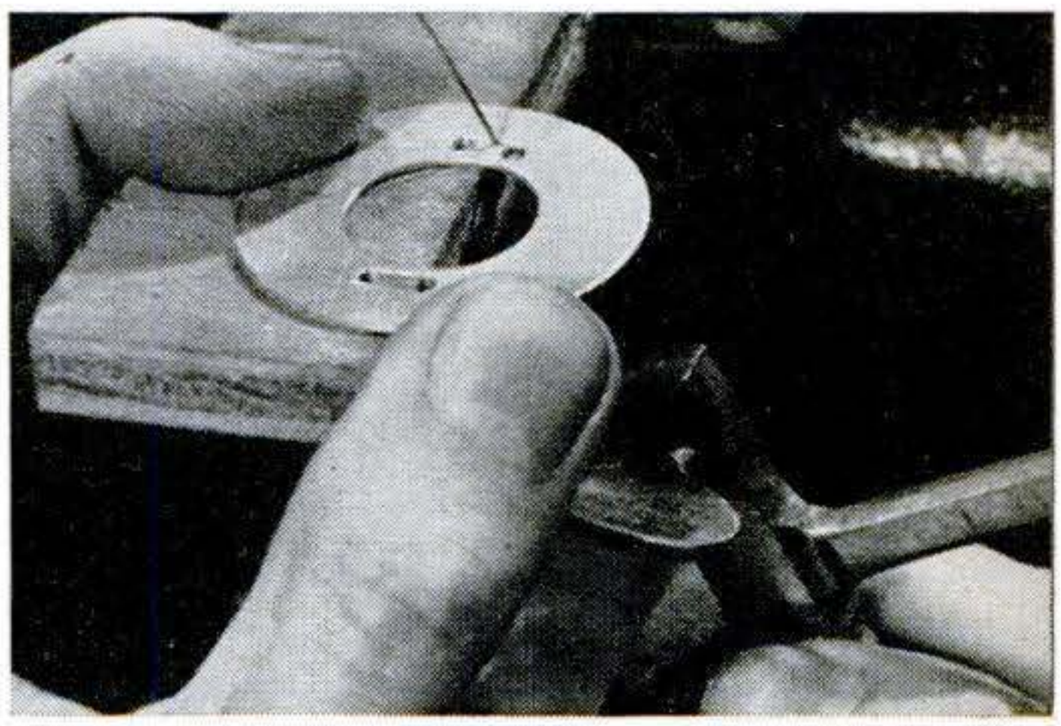
By Walter E. Burton

THESE magnifying glasses will give you close-up, detailed views of sports events and stage shows, but unlike binoculars, they needn't be hand held—you just wear them like ordinary spectacles.

They use inexpensive lenses, and can be made with just hand tools. Of course, a lathe would help in turning the rear lens



Laying out aluminum disks to replace original lenses in frame that supports telescope tubes.



Using a jeweler's saw to cut slots in disks so the telescope tubes may be adjusted laterally.

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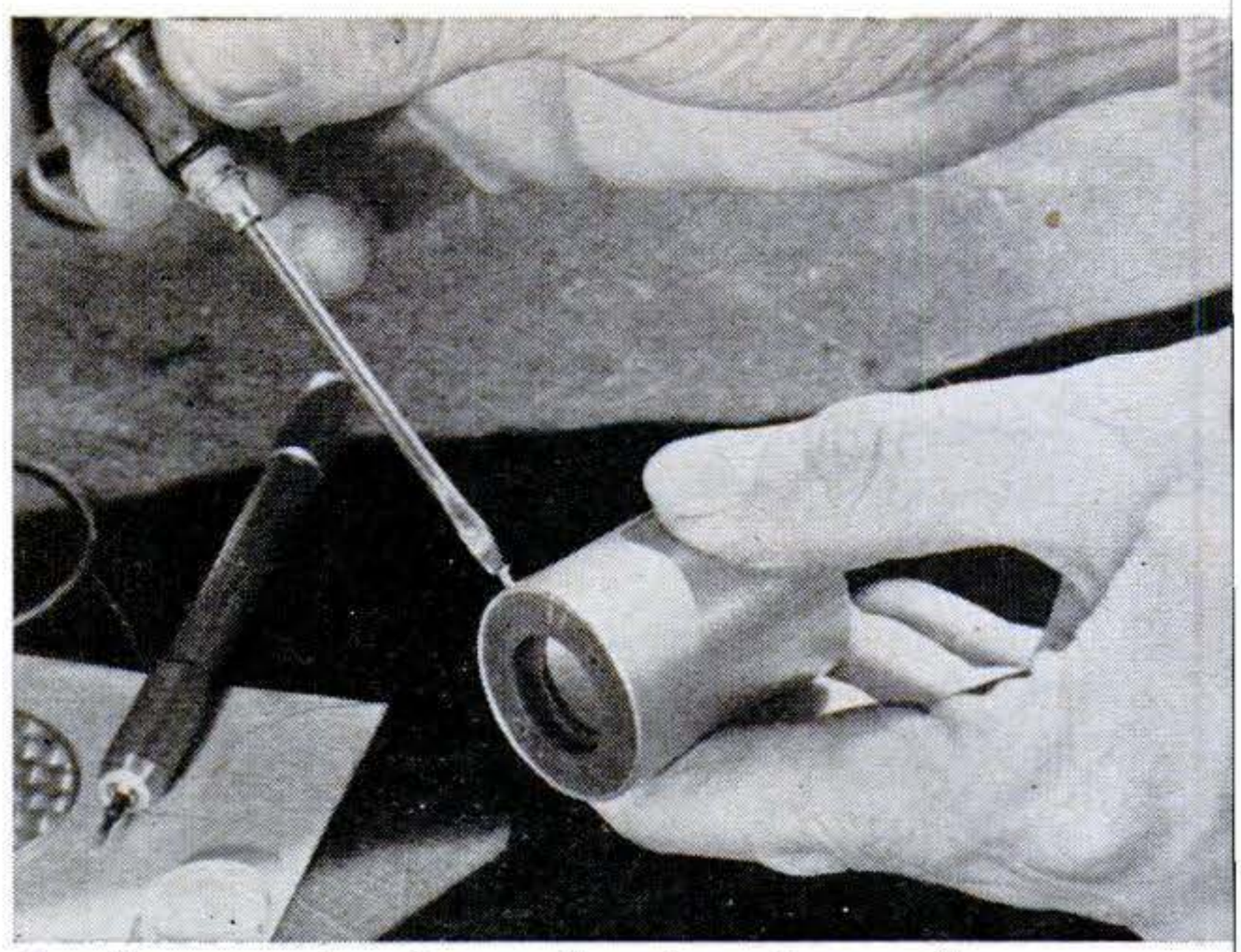
Double-purpose plastic ring acts as rear lens mount and base for fastening tubes to disks.



Small screws or pins anchor the tubes to the ¼″ plastic rings, which are recessed for lenses.

mounts, but you can get along without it. The pair pictured here weigh 2¼ oz. and magnify 2⅓ diameters. To duplicate them, here's what you'll need:

Two positive, spectacle-type lenses of plus 92-mm. focal length and 31-mm. diameter; two negative lenses, minus 39-mm. focal length and 17-mm. diameter; a little .032″ sheet aluminum; a small piece of ¼″ plastic or fiber; aluminum tubing, 1¼″ o.d. and 1 11/64″ i.d.; tubing that slides snugly over it; 2-56 screws; a sturdy spectacle frame, separable at the bow hinges and with 1½″ diameter lens openings; and dull-black optical lacquer. The latter is used to coat the inside of the tube, the holding rings, and the eye side of the two aluminum disks on which the tubes are mounted.

Briefly, construction of these glasses means making two identical Galilean telescopes and mounting them in the spectacle frame in place of the original lenses. You may use lenses of different focal lengths and diameters than those specified here, but in any case the negative lenses, as well as the positive lenses, must be identical. You can find the magnifying power of lens combinations by dividing the focal length of the positive lens by the focal length of the negative lens.

For the body tubes I used the 1¼″ tubing, bought at a war-surplus store. I found that this tubing slid snugly but not tightly inside the lids of Ansco 35-mm. film cans. Also, the front lenses fit nicely inside the lids.

To get an idea of the overall length of the tubes, before cutting the body tubes to length, focus on an object 300′ away and again on a target 25′ distant. With the lenses I used, the body tube was cut 1⅝″ long and the front tube 1″. Other lens combinations will require different tube lengths.

If you use the lids, drill or punch an opening in the top, leaving enough metal to form a ring on which the lens can rest. If you use tubing, peen over the end to hold the lens, or cut a ⅛″ wide ring from the 1¼″ tubing and fasten it in the tube with small screws.

When the front lens is dropped into its tube, it should rest evenly against the turned-in end or against the ring. To hold the lens in place, insert after it a ring cut from the smaller tubing and sprung slightly out of round. A snap ring of springy wire also will hold the front lens in place. Use cement if additional security is needed.

From the ¼″ plastic or fiber, cut a disk to fit in the rear of each body tube. Form the lens recess by boring a hole through the disk slightly smaller than the lens diameter. Then enlarge the hole for three-quarters of its depth to a diameter a little greater than the lens. Fasten the ring in the tube with two or three small screws. Hold the lens in the recess with cement or a snap ring.

With the lenses in place, slip the larger tube over the other and focus on a distant spot. Then mark the position of the focusing slot and its screw. This slot is a diagonal cut in the side of each front-lens tube as shown in the diagram. Cut it with a hacksaw and smooth the edges. Then set a small, fillister-head watch screw in the slot. Fasten

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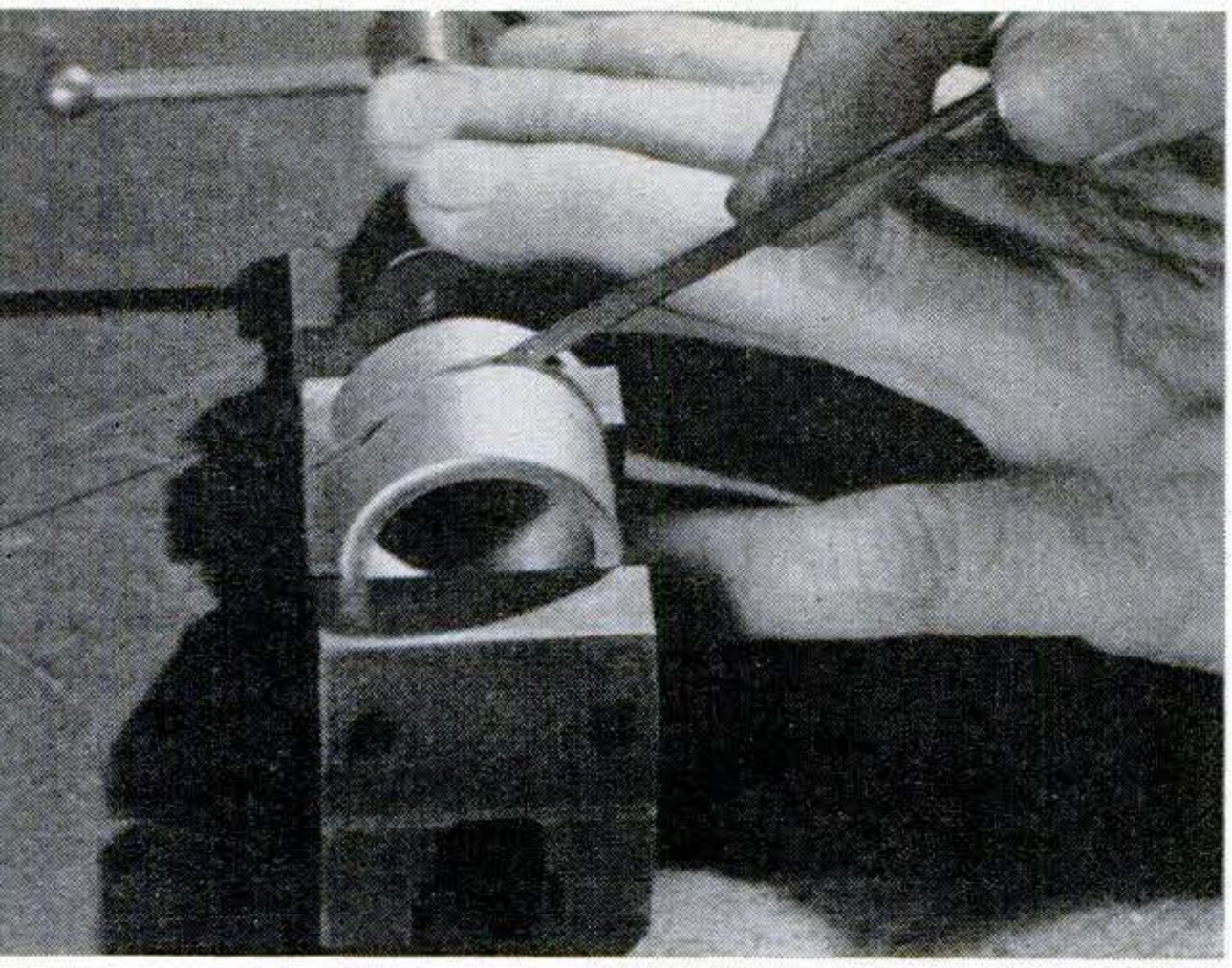
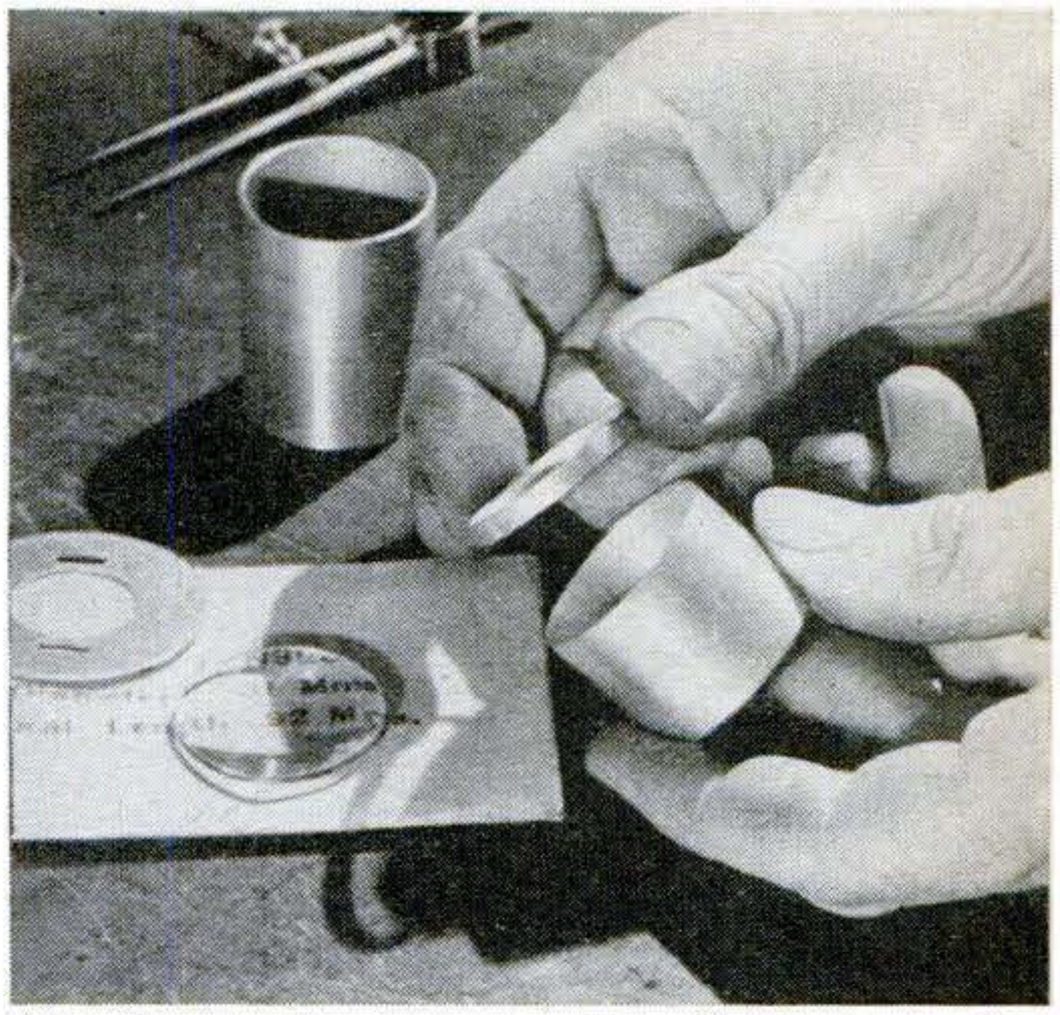


Smoothing slot in front lens tube. A fixed pin rides along the slot as a focusing mechanism.



Aluminum ring or snap ring of wire is used to hold front lens against turned-in end of tube.

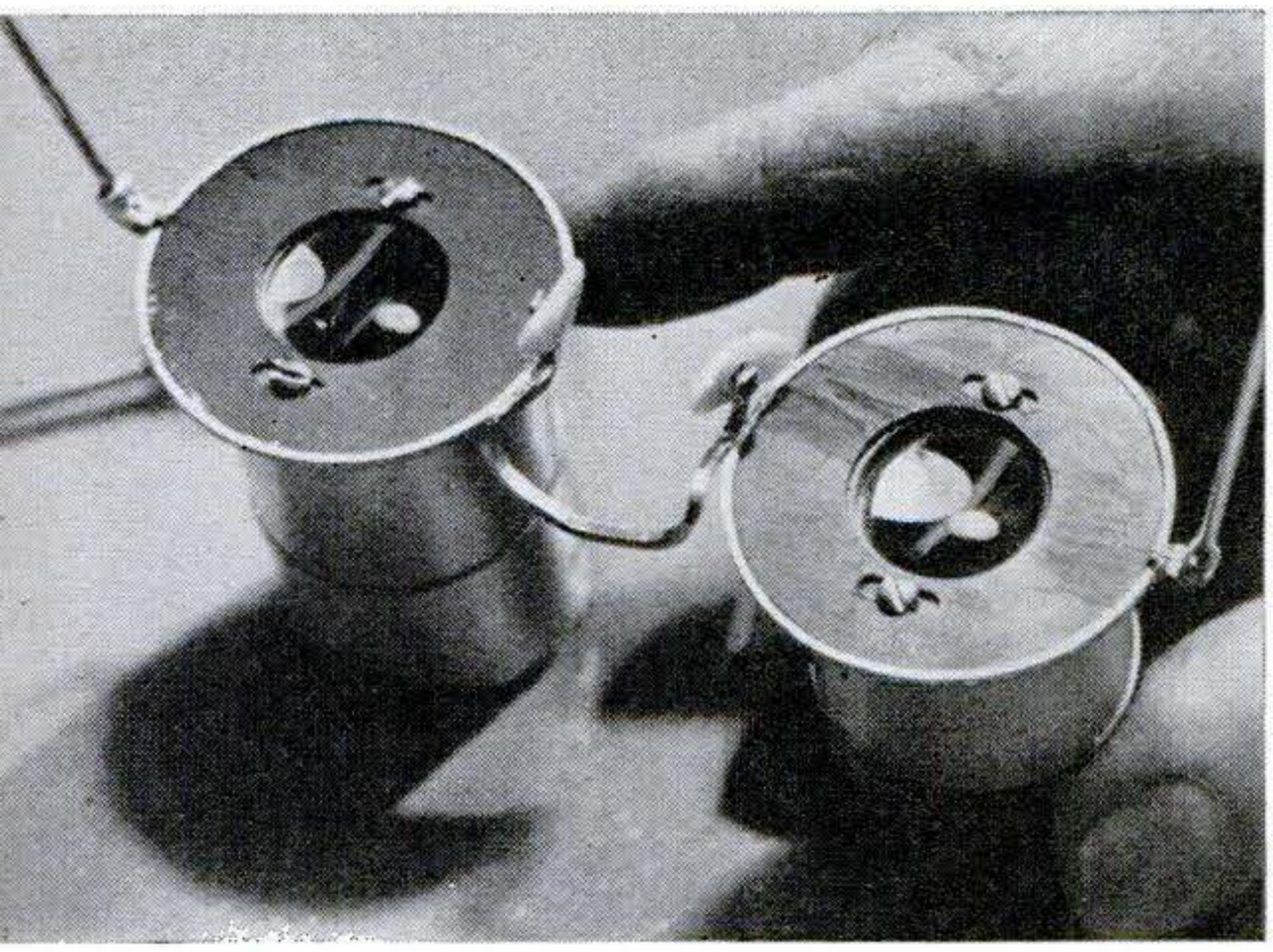
the screw firmly in the tube so its head is at the forward end of the slot when the focus is on a distant object.

Next, lay the spectacle frame on the sheet aluminum and mark the lens openings. Cut the disks slightly oversize to allow for fitting in the grooves of the frame. Drill holes in the disks a little larger than the rear lens.

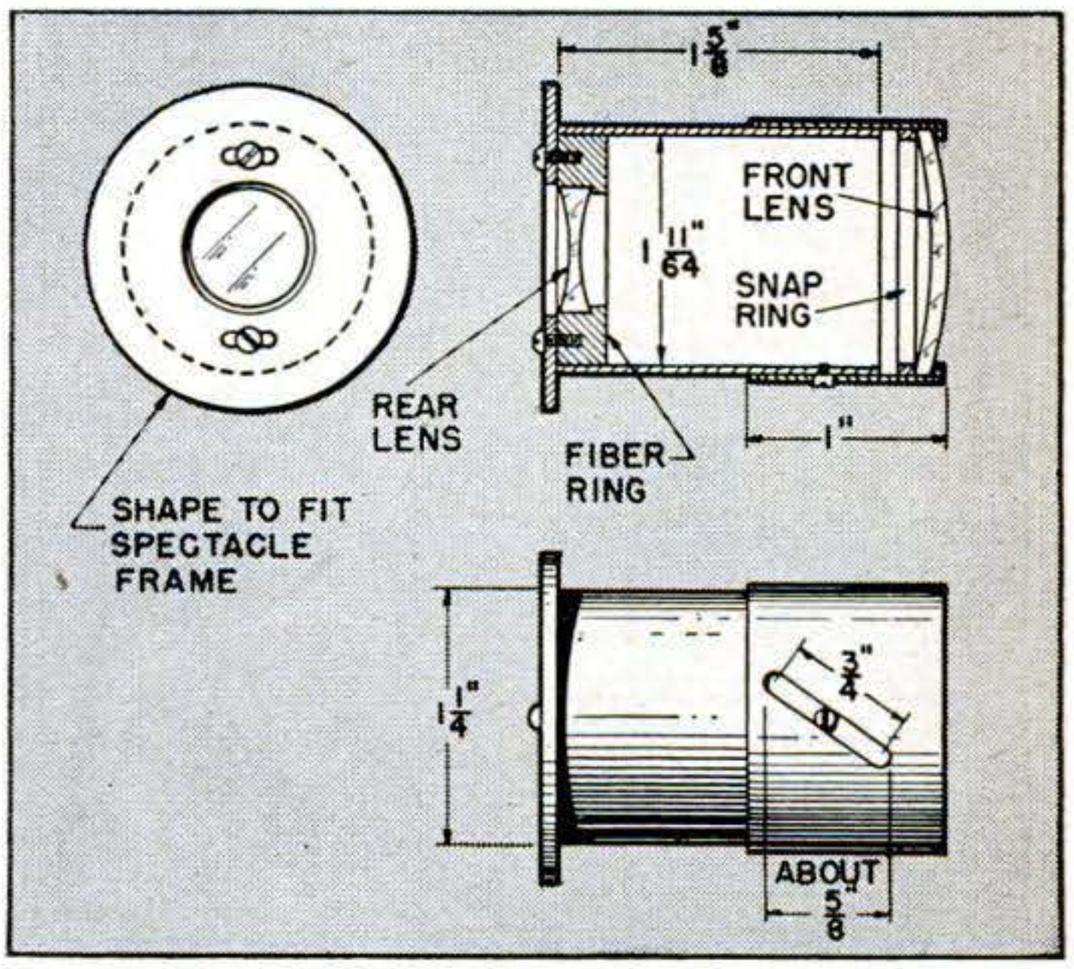
Directly above and below these holes, cut slots for the 2-56 mounting screws. Make the slots by drilling two holes 3/16″ apart with a No. 43 twist drill and removing the intervening metal with a jeweler's saw. These slots permit adjustment of the tubes to suit the distance between the eyes of the wearer.

To focus the glasses, rotate the front-lens tubes. Focus individually for each eye. If the images do not register, bend or twist the spectacle frame slightly until you see a single, distinct object. A knurled ring around each front-lens tube will provide a better grip but adds to the weight unless the tube itself can be roughened.

If you want to increase the power of the glasses, use a rear lens of shorter focal length. A front lens of longer focus would do the same thing but that would mean using longer tubes. For example: if a minus 30-mm. lens were substituted for the minus 39 mm., the magnification would be about three times. To get a practical idea of the magnification, mount only one tube on the frame and look at a distant object. One eye sees it normally, the other magnified. END



Eye end of instrument, showing screw-and-slot arrangement for adjusting the tube separation.



Dimensions here are for rear lens of minus 39-mm. focal length and front lens of plus 92 mm.

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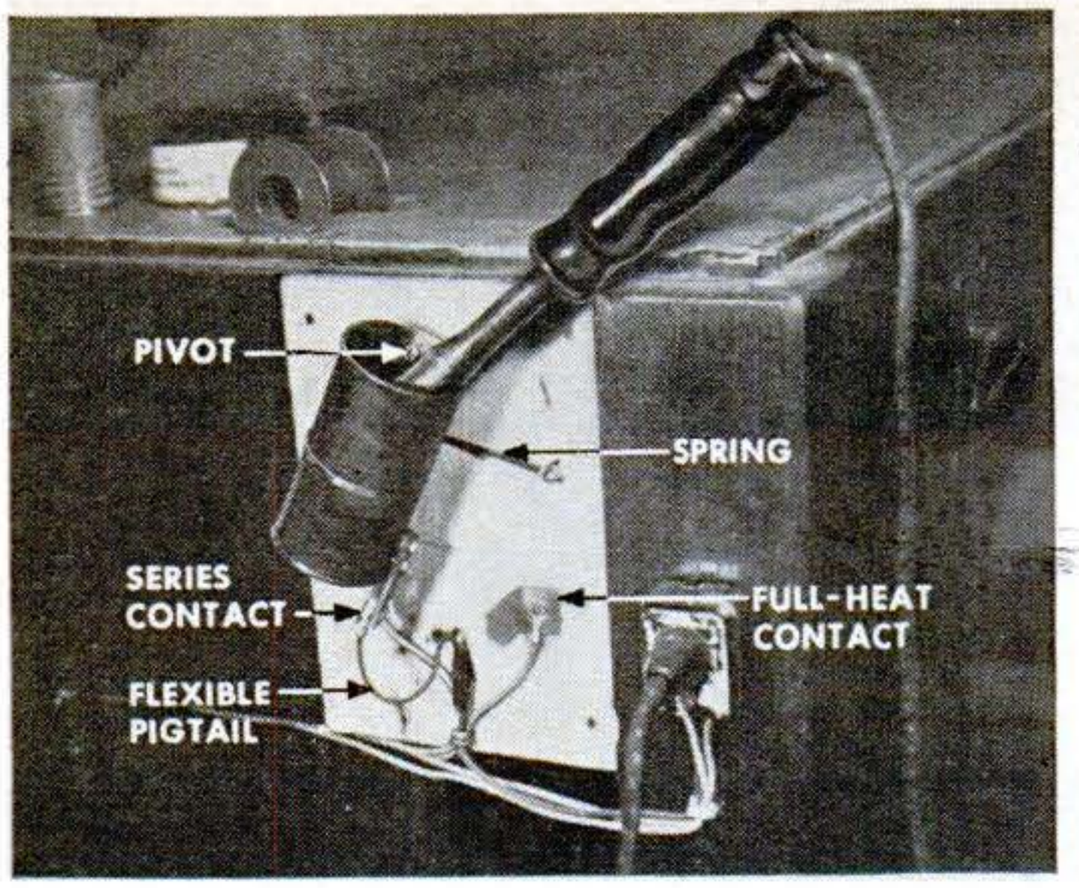
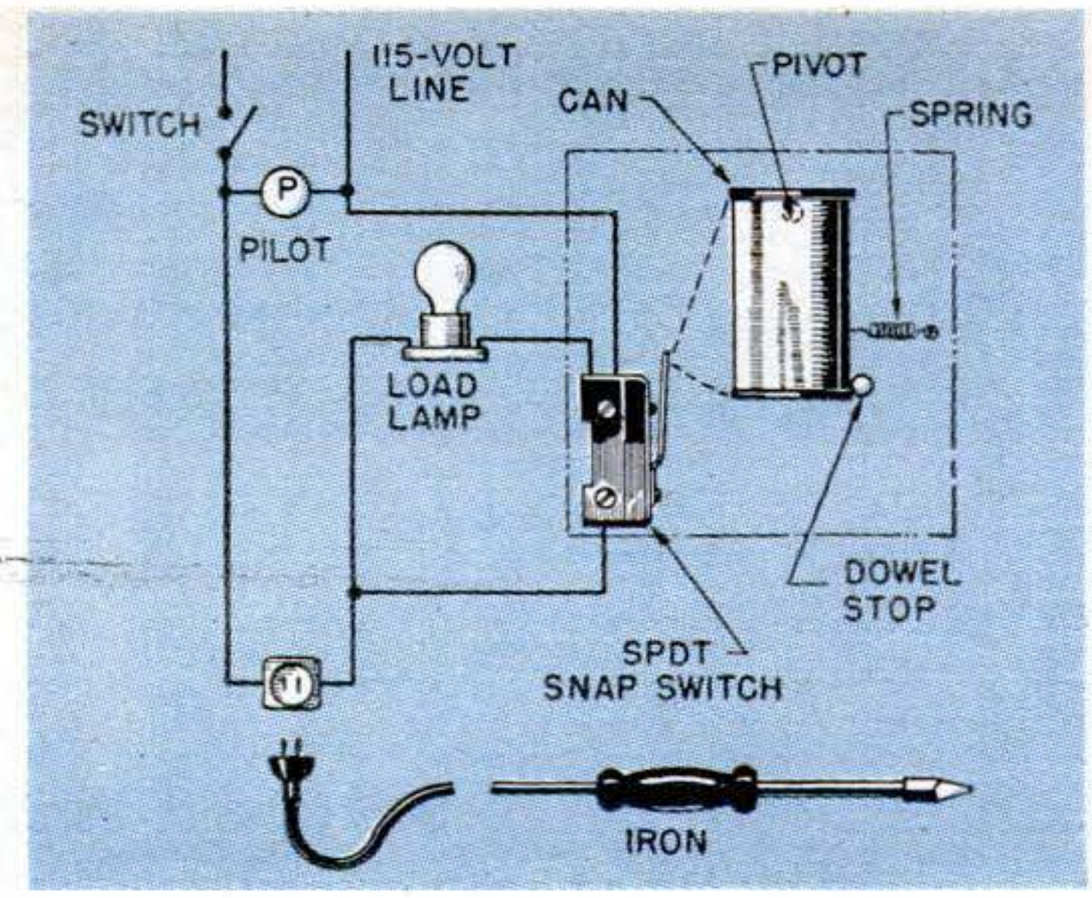




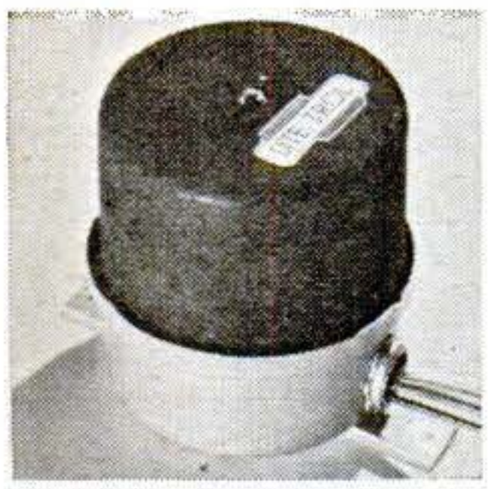
Bench Holder Controls Heat of Soldering Iron

THIS pivoted holder keeps a soldering iron at low temperature, yet automatically switches it to full line voltage when the iron is withdrawn for use. The idling temperature is low enough to prevent pitting of the tip but high enough to permit rapid warmup.

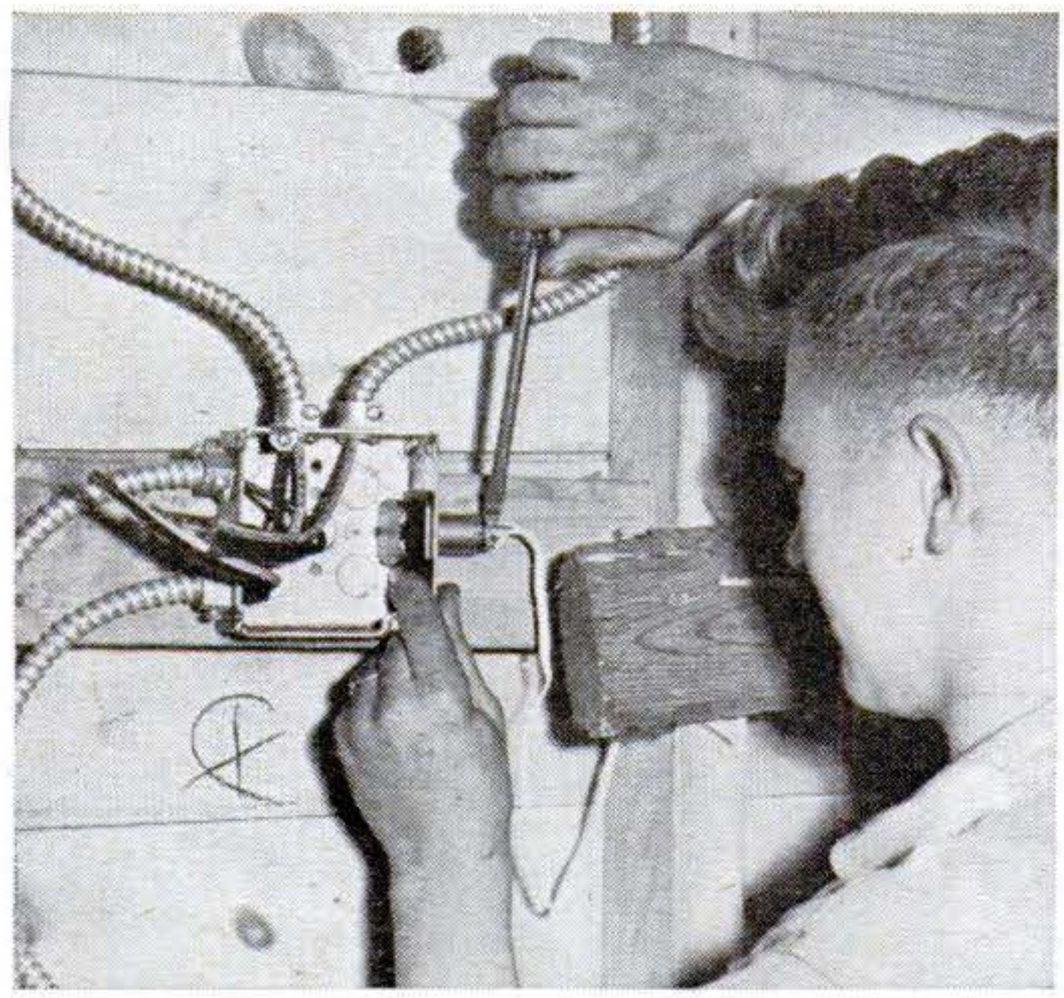
You can either build your own switch or use a SPDT snap-action switch. The center pole of the switch is connected to one side of the 115-volt line. The photo shows a homemade switch consisting of a vertical fiber arm extending below the bottom of a pivoted tin can. Attached to the arm is a bronze contact and a flexible pigtail lead. A brass stiffening plate is soldered to the outside of the can at the top and a pivot hole punched through can and plate. Two L-shaped brass contacts and a piece of light clock spring complete the setup. Try different lamps for various resistance values.

5149

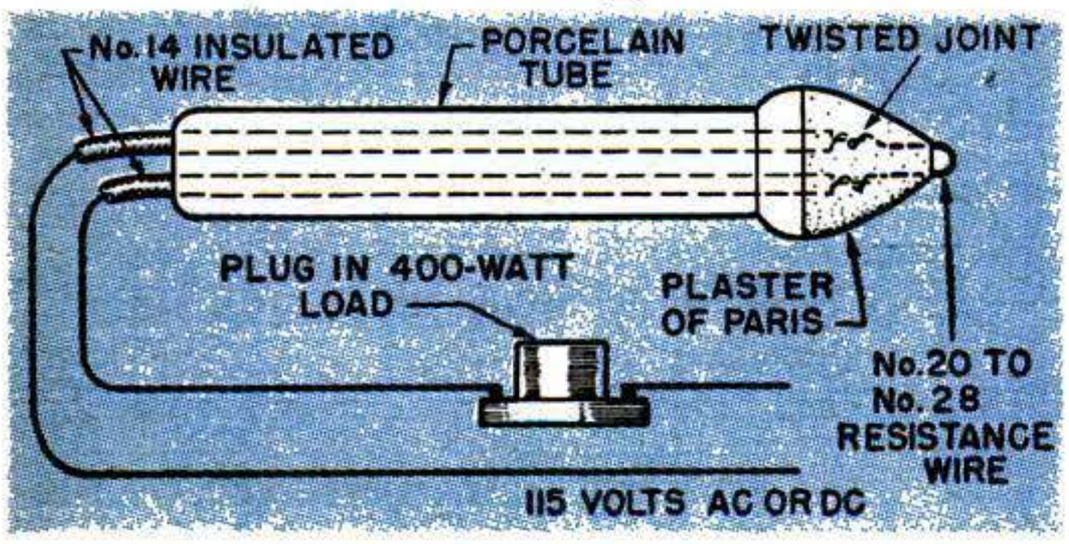
Lights Controlled Remotely



Two new remote-control light systems, both using low-voltage relays, now are on the market. Lite-Trol Ⓣ, at left, is made by Maring Manufacturing Co., Albia, Ia., for farm use. At right, a relay of the General Electric system—for homes, farms, and factories—is being installed. Both systems incorporate transformers to reduce the voltage and consequently use light-gauge wire, such as bell wire, from the push buttons to the relays.



Wood-Burning Pencil Built in Porcelain Tube



MADE of inexpensive materials, this wood-burning pencil will operate in series with a 400-watt load or directly from a 6-volt storage battery. Twist together the leads and the resistance wire, and mold plaster of Paris around the head, leaving a small loop of wire as the point. The pencil I built has given good service for many hours.—*Stanley J. Drazek, College Park, Md.*

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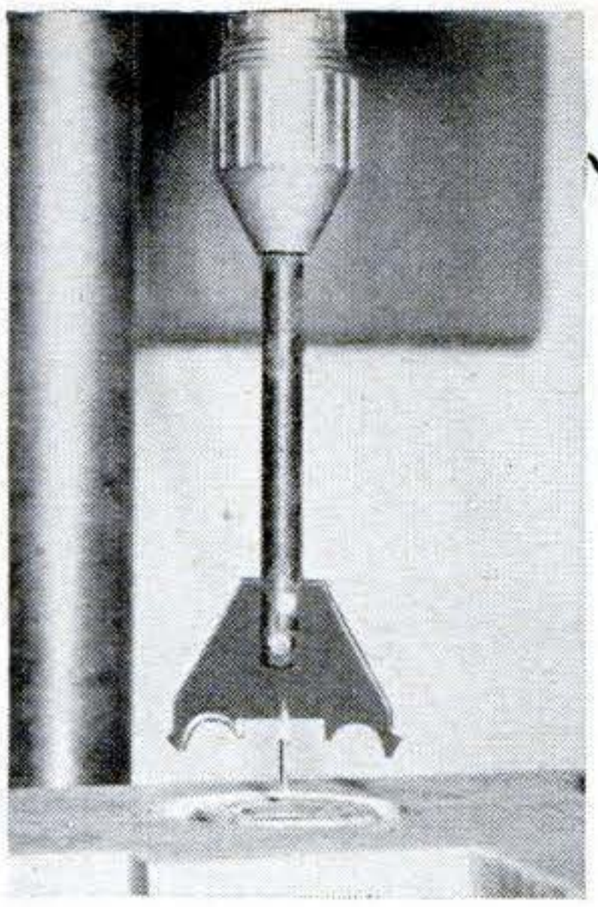
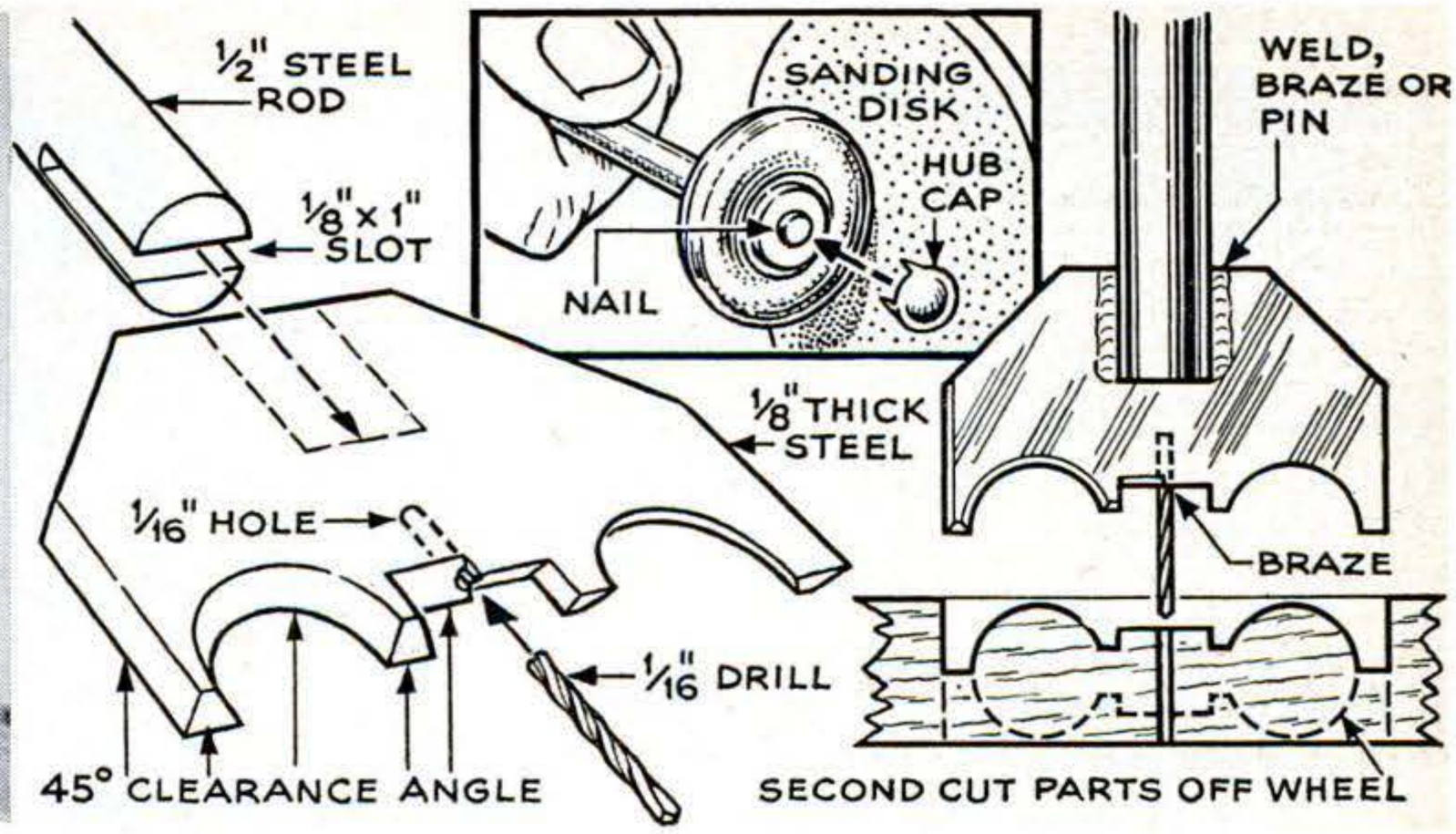




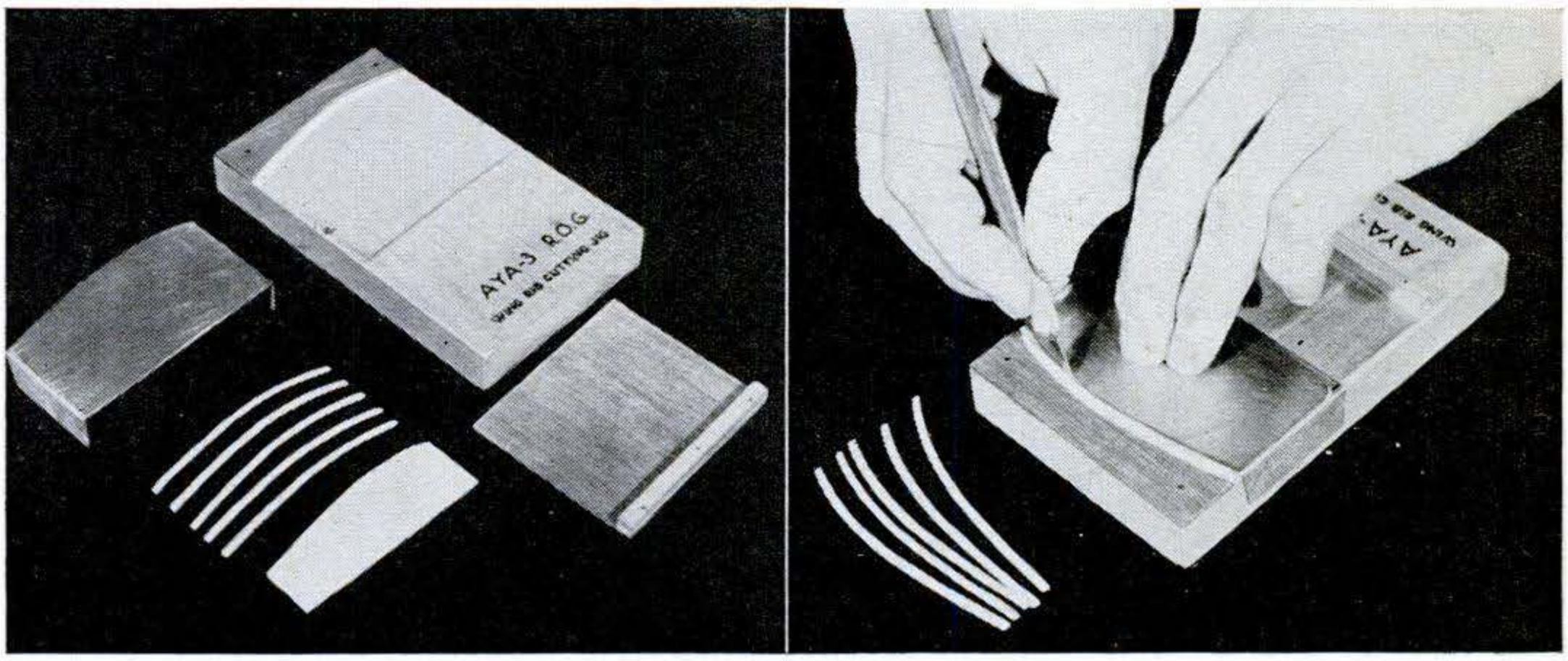
Revolving Blade Cuts Wheels for Small Toys

CHUCKED in a drill press, this revolving cutter solves the problem of making wheels for toys or models. Materials required are a piece of ½" steel rod, ⅛" steel plate 3" square, and a 1/16" twist drill.

File one edge of the plate to the desired profile of the wheel. The diameter of the wheel will depend of course on the distance between the outer edges of the two semicircular cuts in the plate. For clockwise rotation, file the left cutter to 45 deg. on the front edge, the right side to the same angle on the reverse, keeping them symmetrical.

The drill acts as a center pin. Braze or solder it in place. Hacksaw a ⅛" by 1" slot in the steel rod and weld, braze, or pin it to the blade. Operate the cutter at moderate speed. When you've cut halfway through, turn over the stock and complete the cut from the other side.

The wheels may be smoothed off by allowing them to rotate against a sanding disk. A furniture glider pressed in place makes a good hub cap.—*W. H. Greenfield, Reno, Nev.*



Jig Cuts Duplicate Wing Ribs for Model Planes

HERE'S a simple jig that will enable model-plane enthusiasts to cut duplicate wing ribs accurately. The jig consists of a maple base block, a sheet-metal cutting guide, and a cleated push strip. At one end of the base block is a stop strip, its edge having the same curve as the guide. The latter is secured over the base with brads, leaving a gap between guide and stop strip equal to the desired width of the ribs. The balsa stock goes under the guide.

A sheet of balsa is first cut to the length you want the ribs. One edge also is cut to the proper curve. This edge is then shoved under the guide pattern and against the stop strip. After each rib is cut and removed, the balsa is shoved forward with the push strip. —*Glenn A. Wagner, Delmar, N. Y.*

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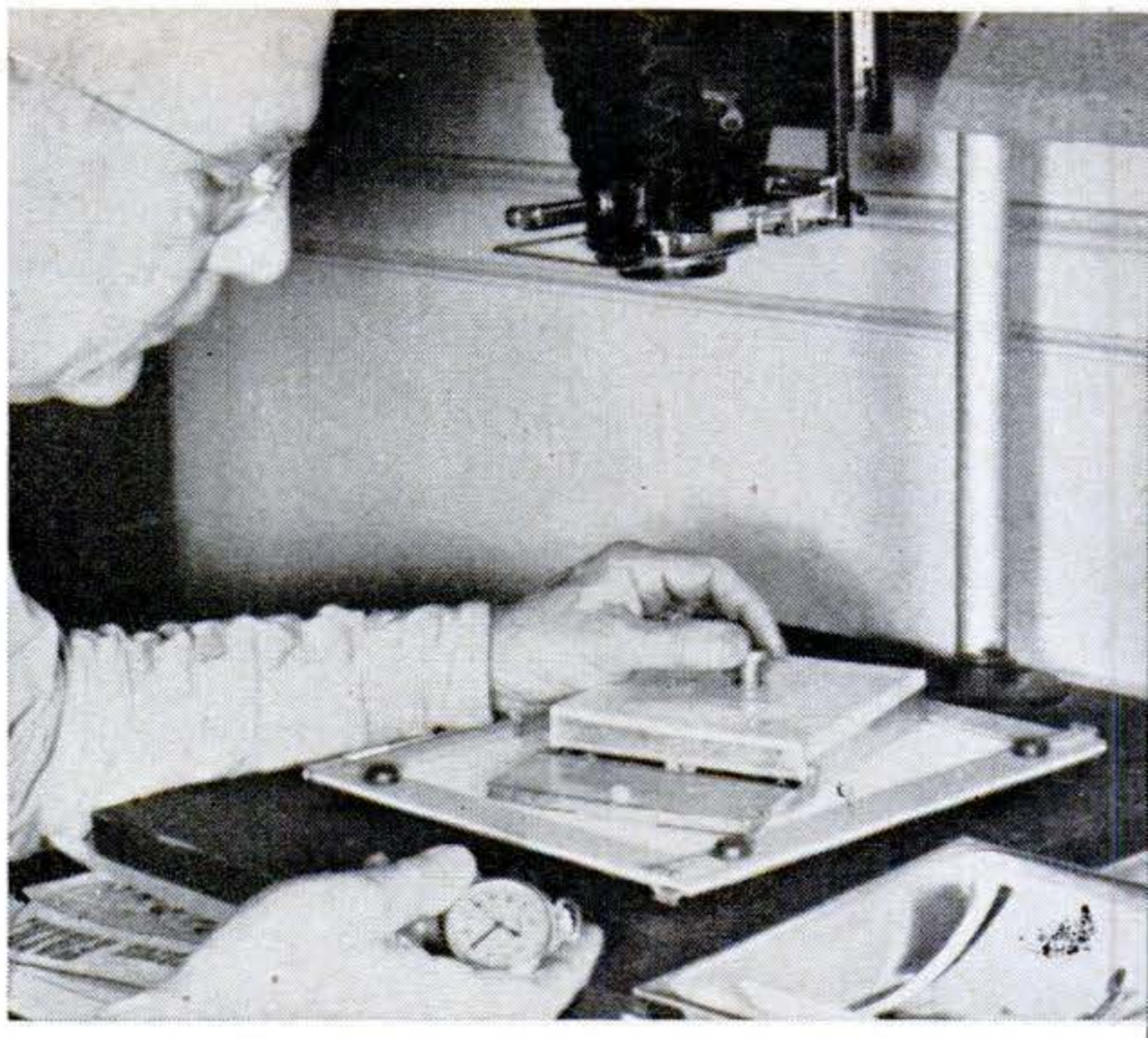
Six tests of the same section of the print are made on a 2 5/16″ by 5″ sheet of paper.



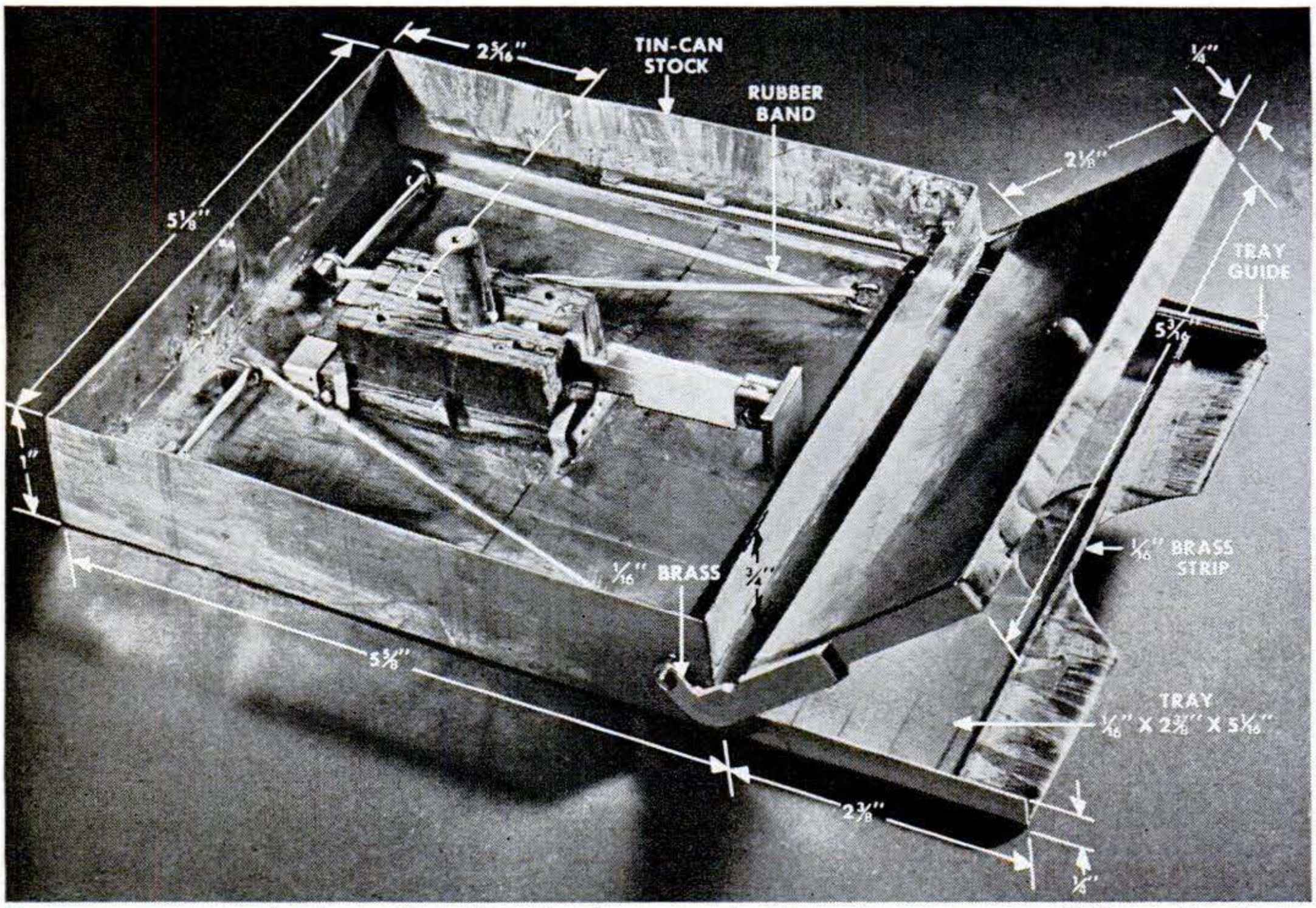
Test-Strip Printer Saves Photo Paper

5373

ORDINARY exposure-test strips give you a series of different exposures of different sections of a negative. This ingenious little gadget does better: it provides a numbered series of exposures of the *same* section, permitting accurate comparisons.

Six test exposures are made on a 2 5/16″ by 5″ strip, giving you three different series from one 5″ by 7″ sheet. The paper is loaded in a sliding tray beneath a hinged cover, and the printer is operated by depressing a button on top. This releases a ratchet mechanism or escapement, allowing rubber bands to advance the paper carrier one notch for the next exposure.

The housing is cut from tin-can stock, bent to the dimensions shown, and soldered together. Hinge the lid that covers



Exposures are made through a ¼″ slot between the hinged tray cover and the wall of case.

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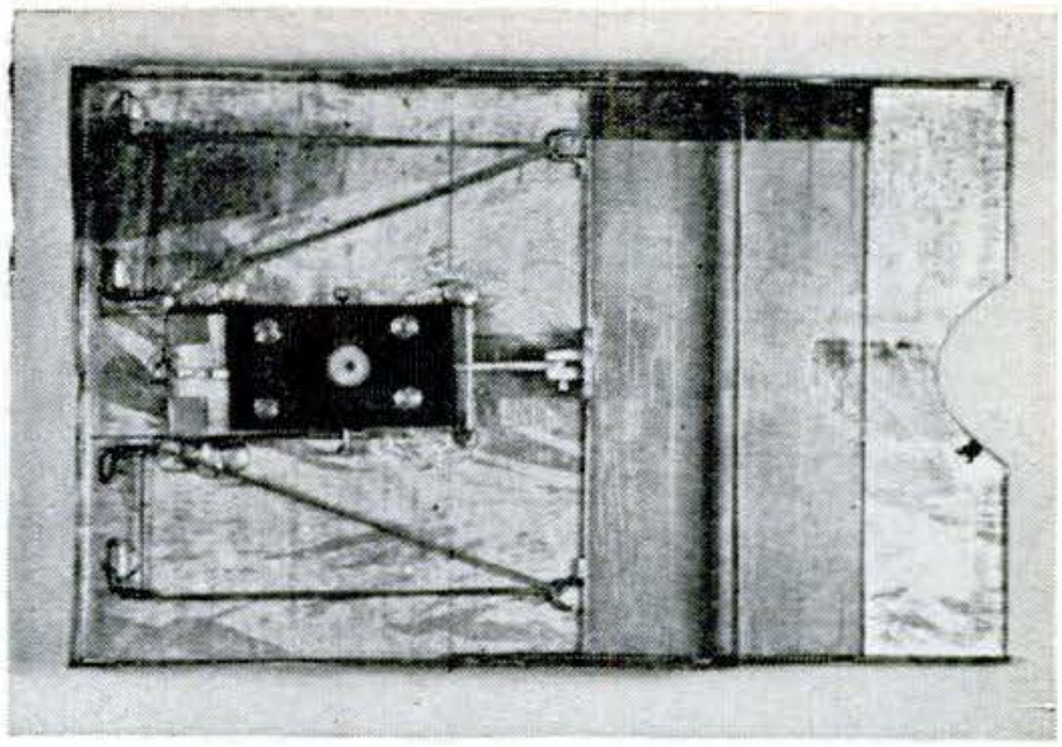
the paper tray. A piece of wire soldered to each inner side of the case guides the tray.

Make the wood base for the ratchet mechanism in two parts, each ¼″ by 1″ by 1″. Cover these with tin on one face and one edge. The two 7/16″ by ½″ by 1¾″ wood members above this should be separated just enough so that the 1/16″ aluminum ratchet bar will slide easily between them. Drill the ½″ dowel hole after clamping cardboard 1/16″ thick between the wood parts; the dowel shouldn't be a sloppy fit.

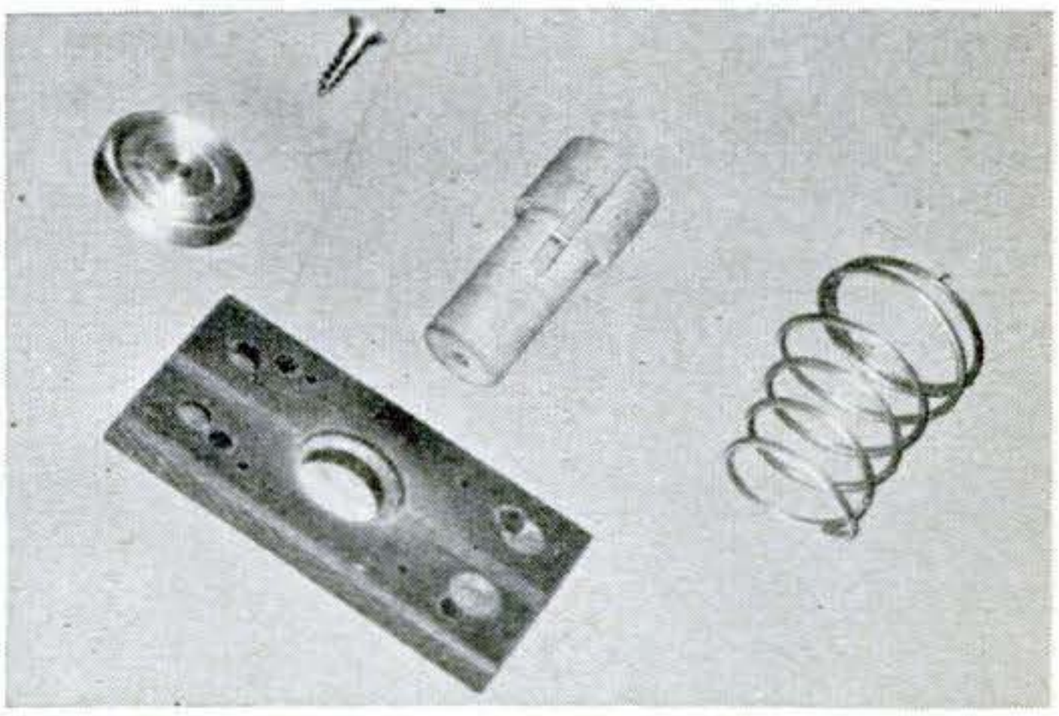
When these parts have been assembled, deepen the 1/16″ slot between the two base members. This provides space for the 1/16″ by 1⅜″ wire—the ratchet pin—to engage the sawtooth notches in the bar. The two springs that lift it are cut from safety pins.

For proper operation of the mechanism, the pin in the dowel must be located exactly 1/16″ off center. When the button is depressed, this pin engages one of the slots in the upper edge of the bar, preventing the latter from running away. The 11/16″ dimension on the section view represents the depth of the dowel slot.

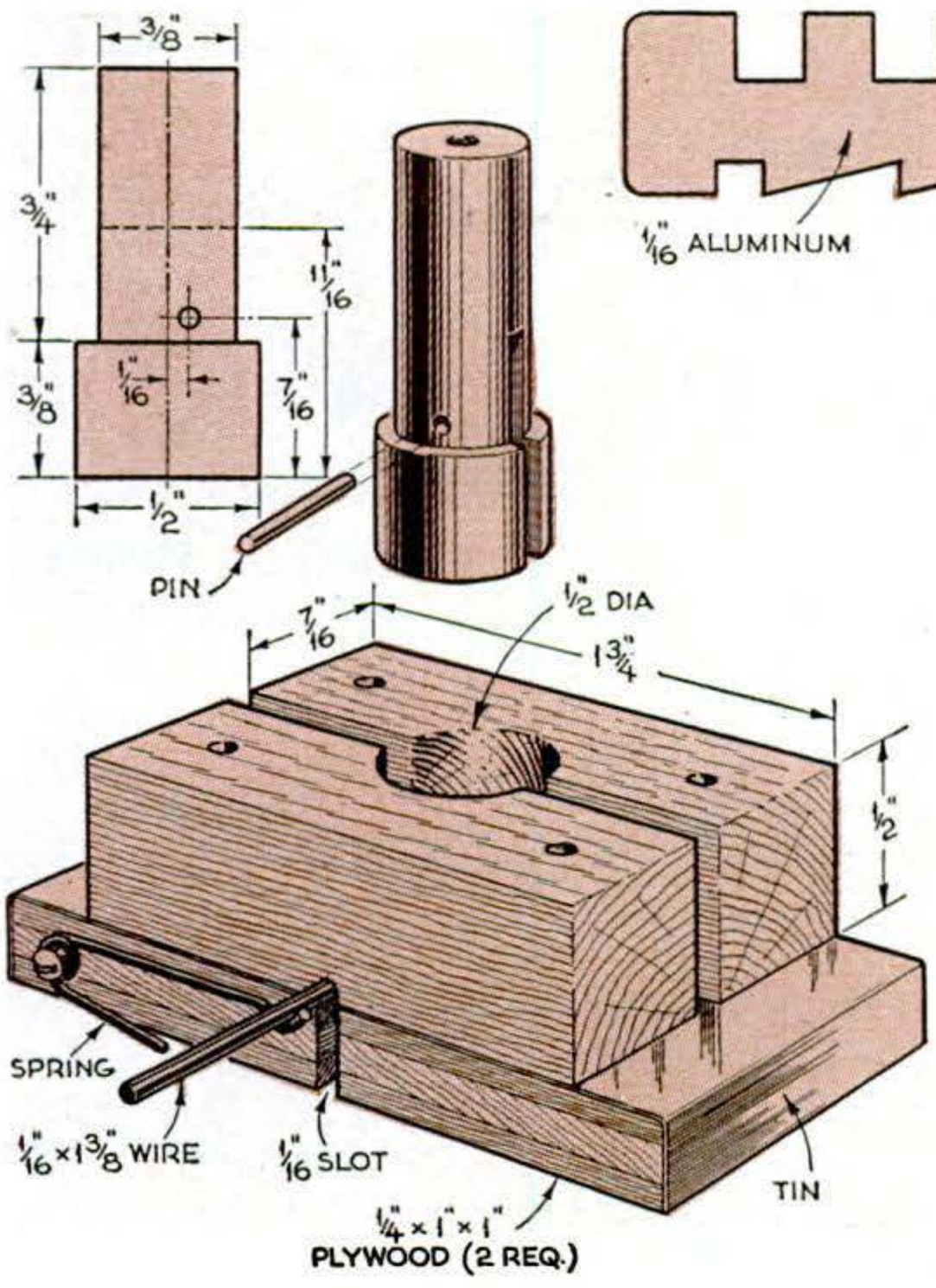
The ratchet bar is pivoted in a forked upright soldered to the edge of the paper tray. Make a tin cover with a hole for the button.—*Joseph F. Gréce, Bronx, N. Y.*

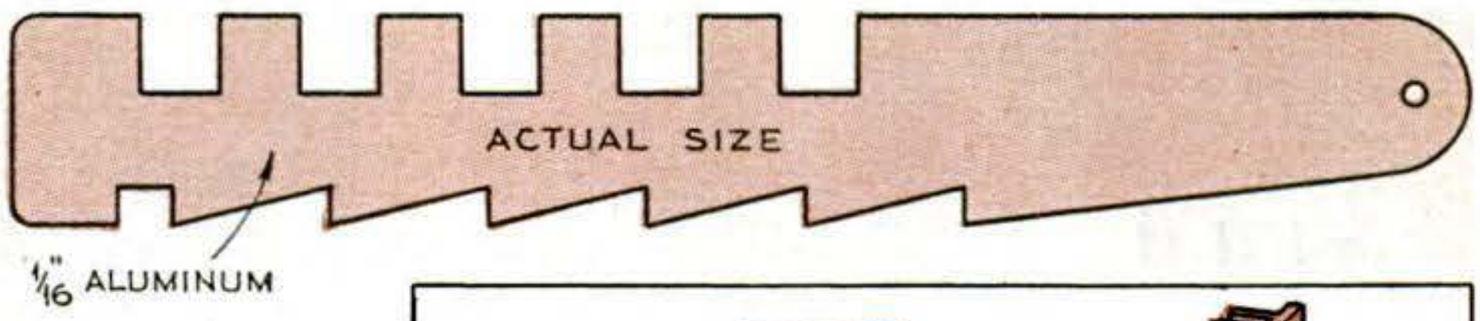


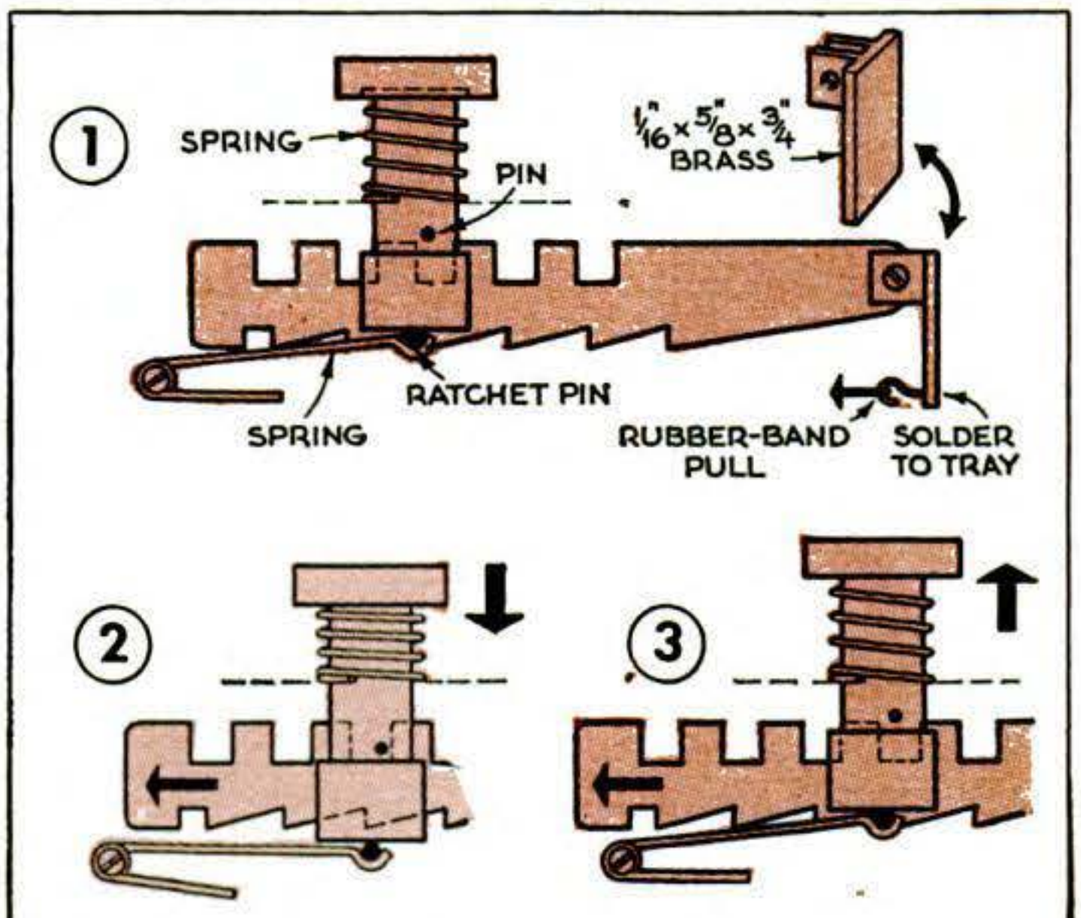
Figures inked on a clear film strip supported at end of tray automatically number exposures.



A cover, lower left above, goes on top of the ratchet-mechanism base shown in sketch below.







Here's the action. At rest, the ratchet pin engages a sawtooth (1). But push it free (2) and the bar moves left until the dowel pin stops it. Remove pressure (3) and the ratchet pin again engages.

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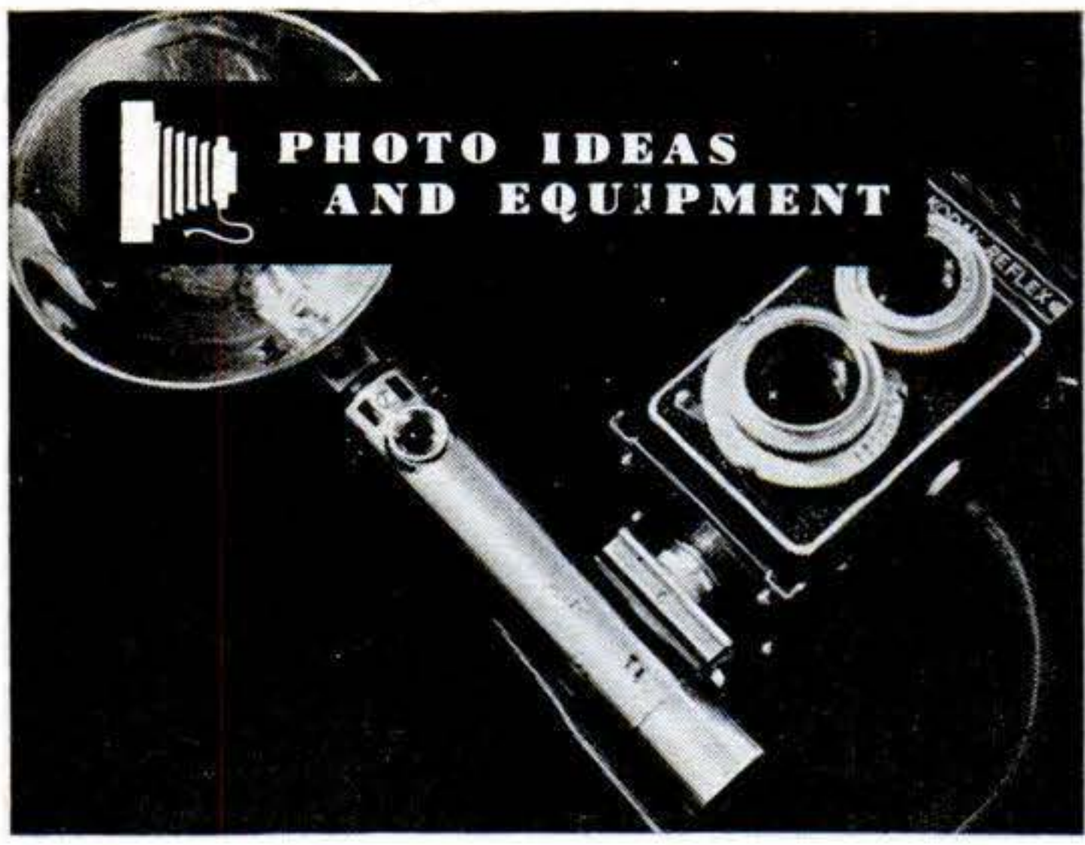
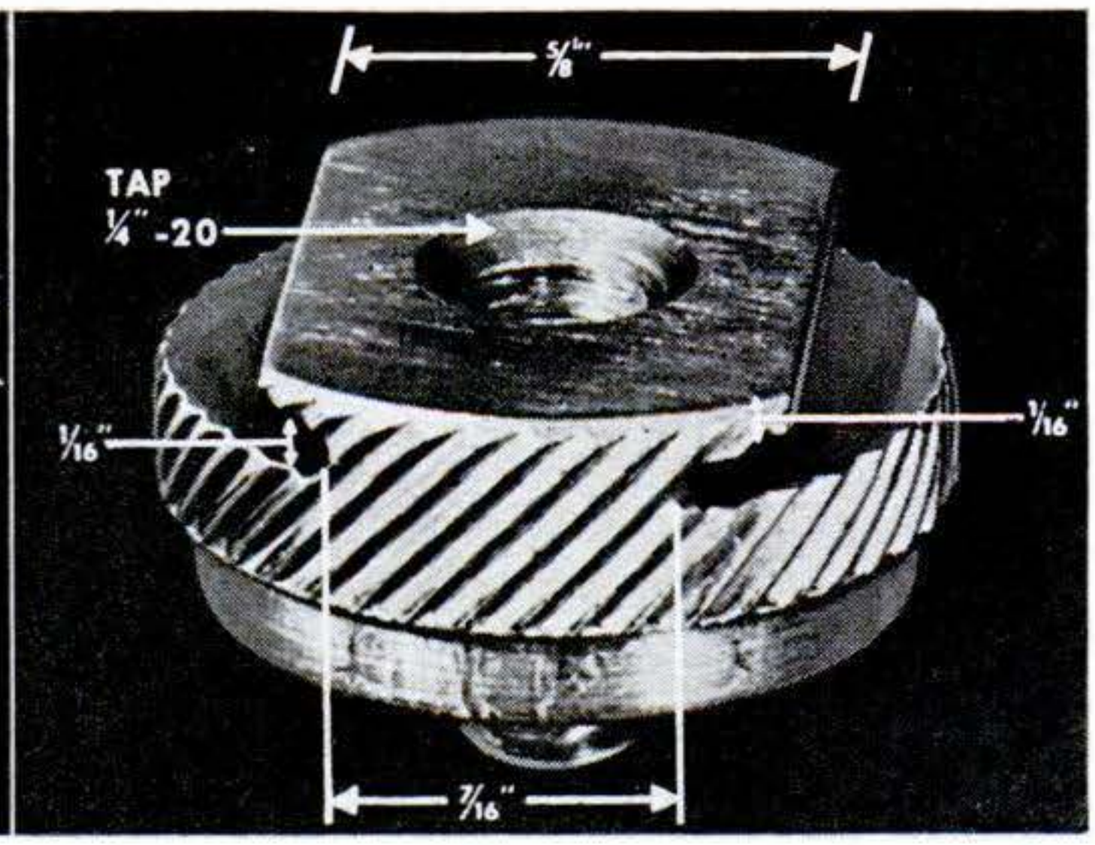
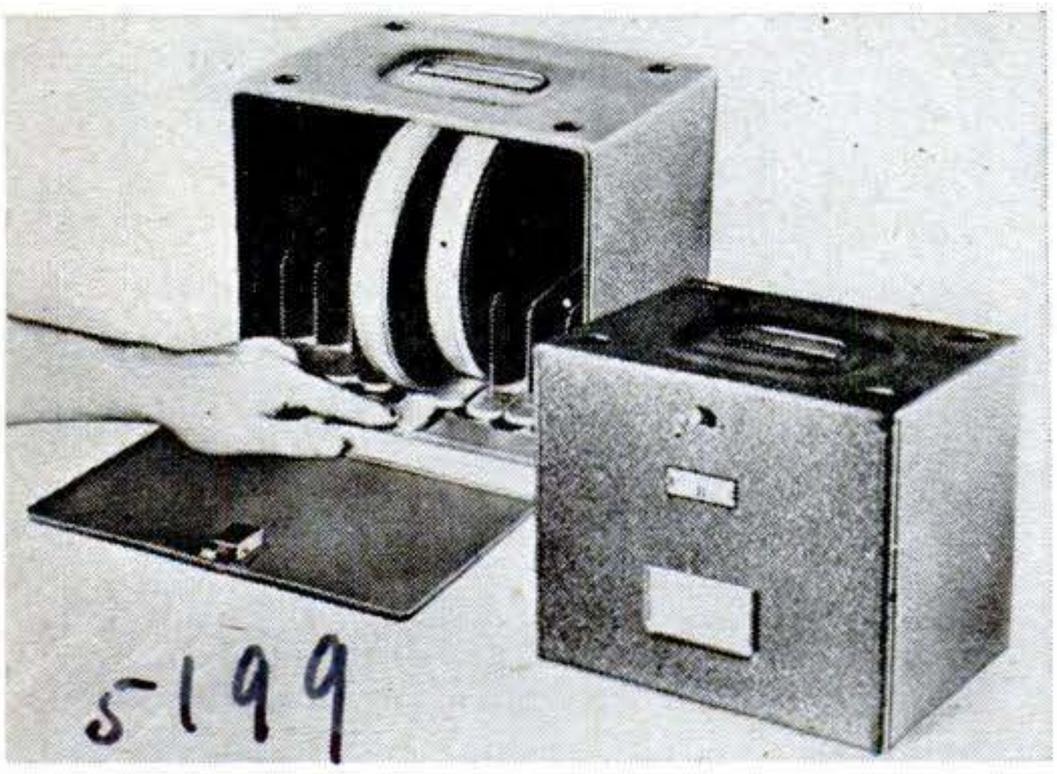


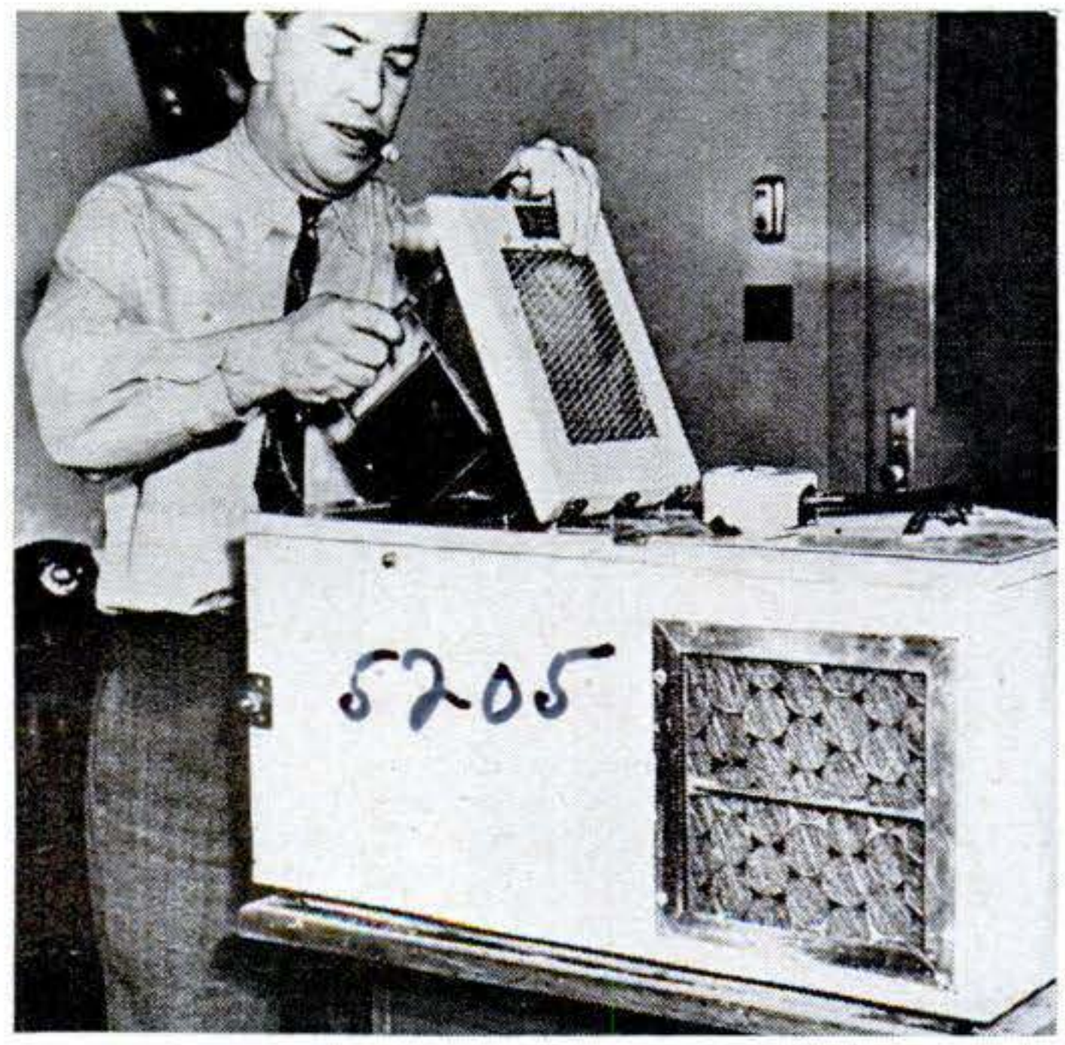


Adapter Holds Flash Gun. Flash guns with T-slot mountings may be attached to the tripod socket of almost any camera with this adapter, which is made from a standard aluminum tripod screw. Turn the screw tightly into the tripod socket and scribe a line on it in the direction the gun is to be mounted, to insure proper alignment. Remove it and hacksaw two vertical and two horizontal cuts, following the dimensions shown above. Finish the cuts with fine files or a hand grinder. Suitable variations for other flash guns may be suggested by this.—*Jack Wilson, San Pedro, Calif.*



5199

Push Button Selects Reel. These new reel cases for 8- and 16-mm. film have levers that retain reels in the opened case. If you push a lever down, the reel selected rolls out. Made by the Brumberger Co., Brooklyn, N. Y., the welded steel cases come in three sizes. The largest holds up to nine 16-mm. 400′ reels and sells for about $7.50.

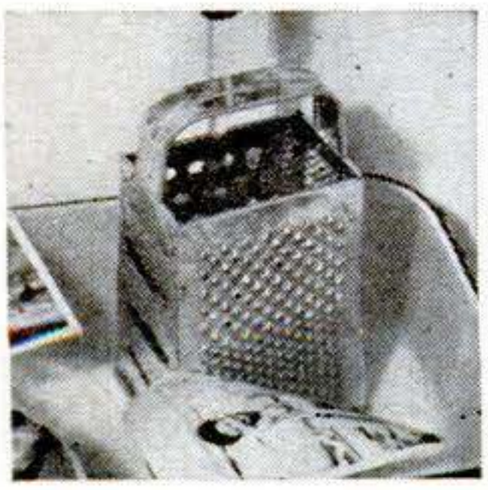


5205

Three-Minute Negative Drier. This negative drier incorporates an electric fan and a ring heater taken from an electric stove. Capable of drying negatives in three minutes, it was built by Leo F. Long, assistant mechanical superintendent of the Toledo Blade, for that paper's photographers. The galvanized-iron case is 11½″ wide, 12″ deep, and 28″ long. Air is sucked into the case through two 10″ by 10″ Fiberglas® filters and blown across the heating element before it reaches the negatives. A thermostat mounted on top of the case controls heat. Screening is used in the lid and front of the box for air circulation. The dust-catching filters are changed about every two weeks.

5294

Grater Circulates Water. An ordinary kitchen grater provides good water circulation in a pan of washing prints. Place the grater in the pan and run the water in at the top. One advantage of the setup is that the water can't harm film emulsion.—*J. A. Silver, Tracy, Minn.*



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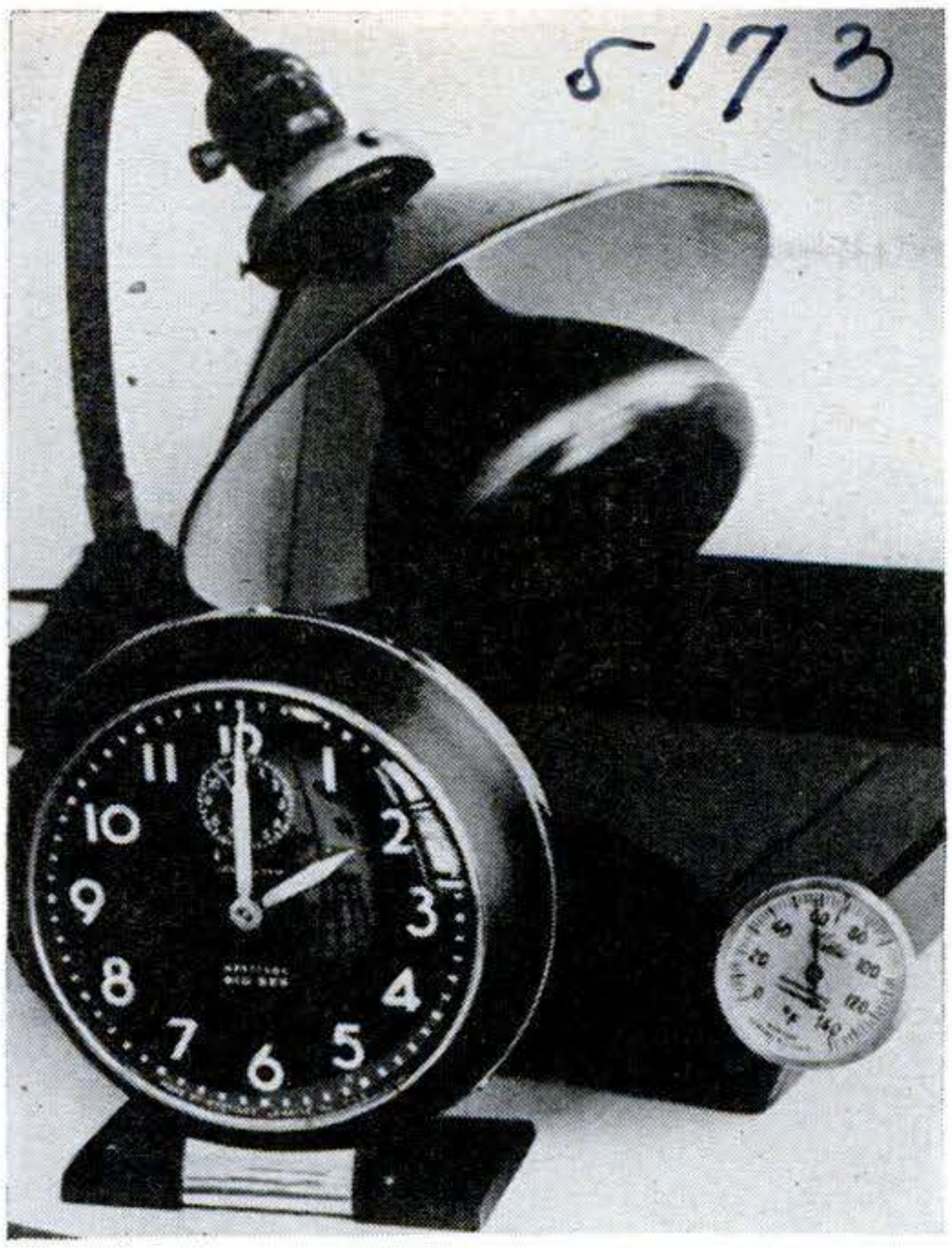
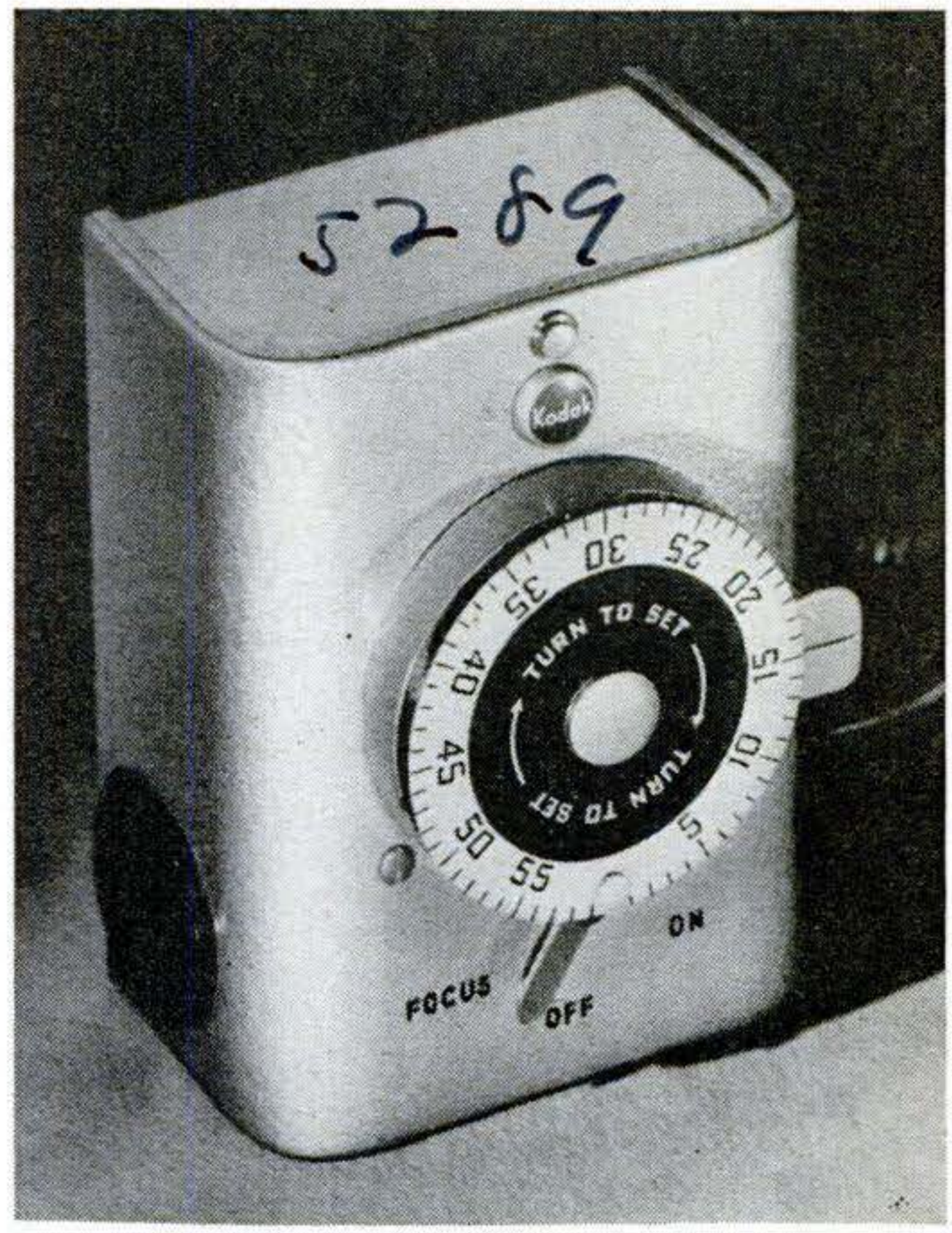
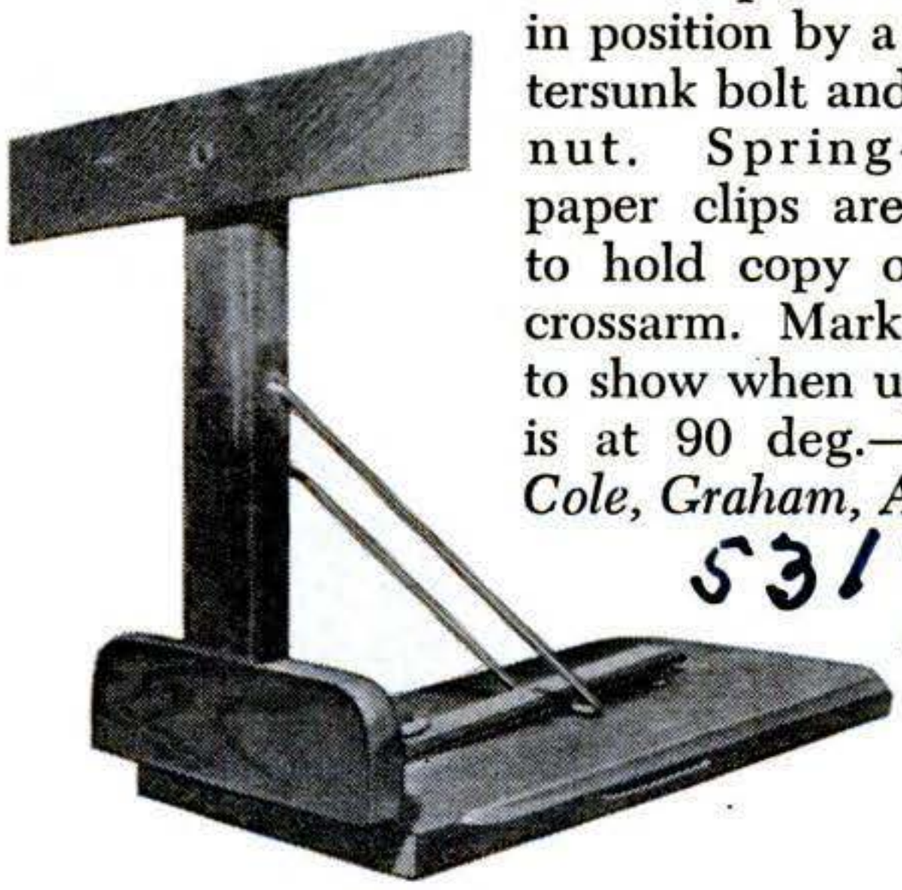


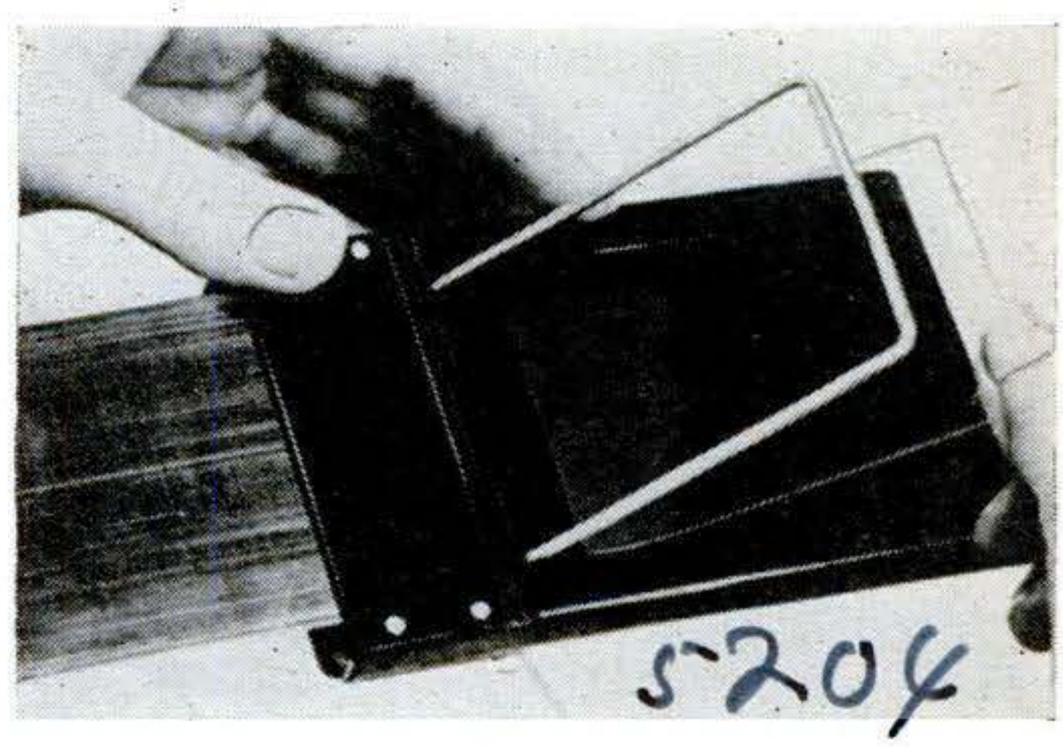
Lamp Warms Solutions. Photo solutions that have dropped below recommended working temperatures can be warmed quickly and simply with an infrared heat lamp. Solutions heated in this manner tend to remain at correct temperatures longer because the rays warm both the liquid and tray. The lamp also is handy for speeding the drying of washed film and prints.—*Mike Clary, Seattle, Wash.*



New Electric Timer. With a range of from one to 57 seconds, the Kodak Electric Time Control Ⓣ provides for individual print timing, repeat timing, and light for focusing. A keyhole slot in the back permits hanging it on a wall or bench. Dimensions of the control are 2½″ by 3¼″ by 4⅜″. Its maximum electric load is 7 amp. on 110 volts AC. Priced at $15, it is available through Kodak dealers.

Holder for Copy Work. Here's a collapsible easel that's handy for horizontal copying. The upright piece, hinged to the 12″ by 18″ base, is braced by ⅛″ brass rod. An adjustable cleat, held by a ¼″ bolt through the base, anchors the rod to the base while the crosspiece is kept in position by a countersunk bolt and wing nut. Spring-type paper clips are used to hold copy on the crossarm. Mark cleat to show when upright is at 90 deg.—*C. A. Cole, Graham, Ala.*





Holder Grips Film. A U-shaped wire, hinged inside this new film holder, is lowered to grip the edges of the film. Snubbers hold the wire securely in position. The holder eliminates sliding cut film into channels or a sheath; instead, film is just laid in place. Made by Burke and James, Inc., of Chicago, the all-metal double holder fits standard press cameras.

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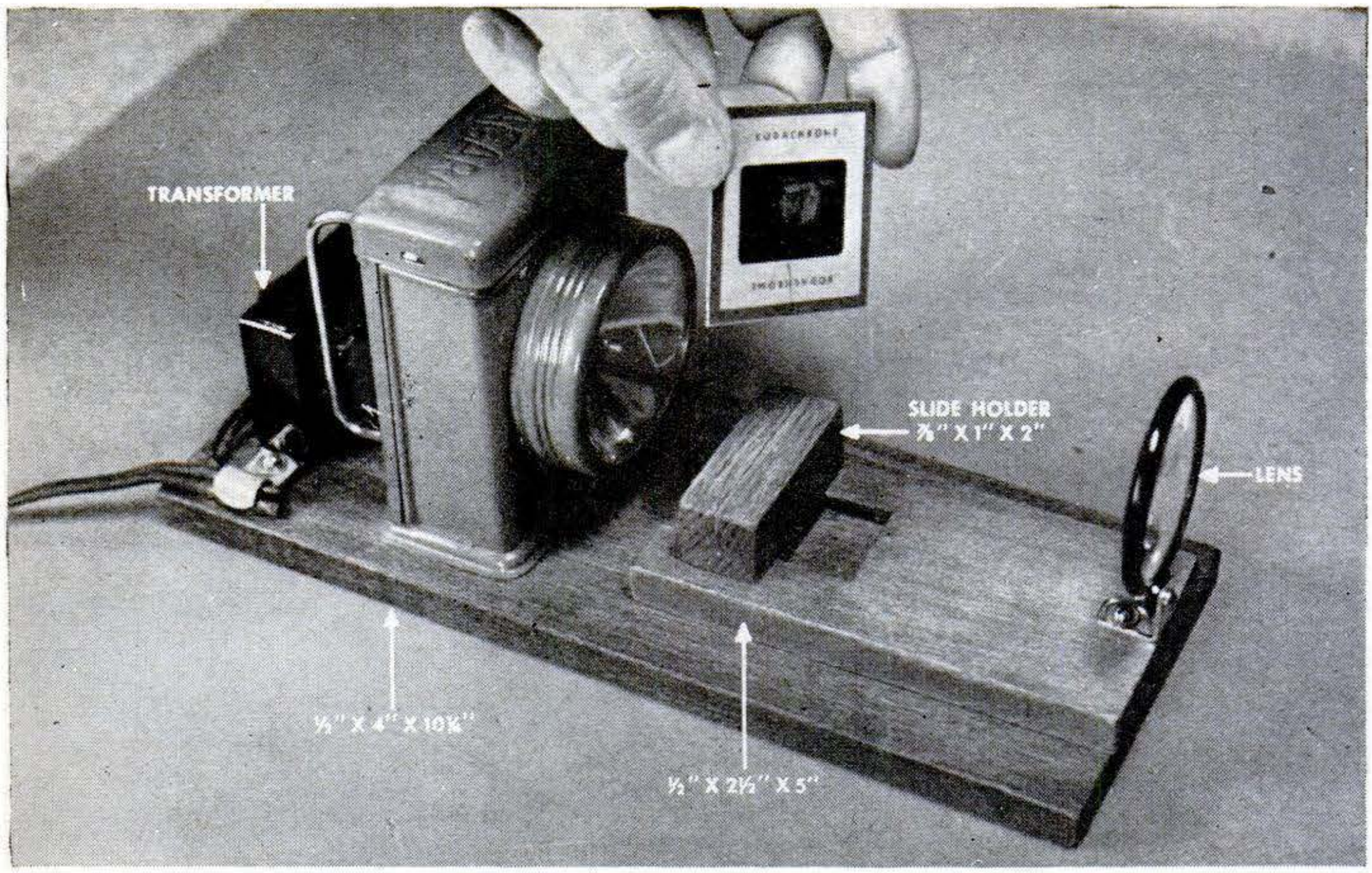


Transparencies are slipped into a slot cut in the holder. Make the slot about ⅜" deep.

5310

Low-Cost Color Projector Built from Flashlight

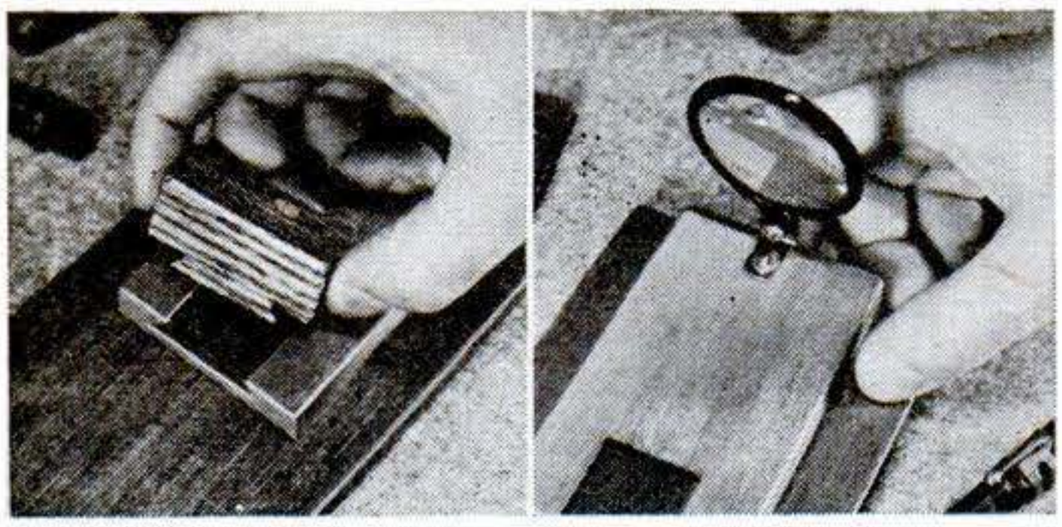
AN EVENING'S work plus $4 will give you a 35-mm. projector that plugs in anywhere, doesn't heat up, and will enable you to see your color transparencies much enlarged.

Although it can't match a high-quality commercial projector, this simple one beats squinting through a viewer. It was built around a flashlight that sells for 70 or 80 cents. The lens is an inexpensive one of the type used by stamp collectors.

When you're collecting the materials, a visit to a radio parts store is in order. There you should buy two items—a filament transformer and a brown-bead bulb with a miniature screw base rated at 6-8 volts. Be sure the filament is not too near the top of the bulb. Otherwise, you will have difficulty focusing it.

If you prefer, you can use a 6-volt bell transformer, but the filament transformer is more compact and gives the projector a neater appearance. The one I used, a Stancor P-6134, was rated 6.3 volts and 1.2 amp.

Take the flashlight apart and fasten the case to the wood base with screws. Mount the transformer directly behind. Drill the



Slides are focused by moving the holder back and forth in a dovetail slot in the base. The magnifying lens remains in a fixed position. Center it at the front end of the baseboard.

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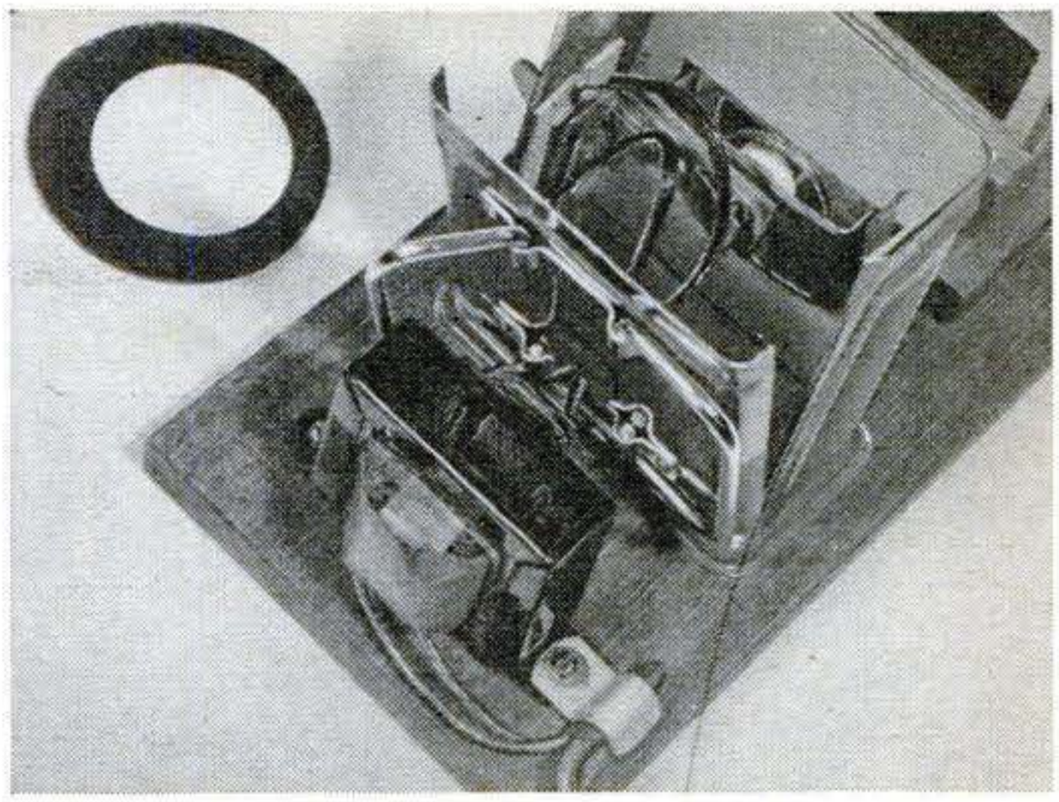
back of the case for a grommet and feed through the two wires (usually coded black on filament transformers) from the secondary. Solder these to the points inside the case that originally served as the negative and positive contacts for the batteries.

Should the filament transformer have three leads on the secondary winding, tape up the centertap lead. This is usually identified by being a different color.

Solder the leads from the primary winding to the line cord and tape the joint. Anchor the line cord with a cable clamp.

In order to prevent flare from washing out the picture, I painted a black ring around the edge of the glass face of the flashlight. Before doing this, it'll probably be best to experiment with a ring cut from black paper.

When you're ready to use the projector, keep the screen fairly close—say 3′ to 6′ away. At 3½′ my lens gives a picture about 9″ by 13″. At 4½′ the image size goes up to about 12″ by 18″, amply large for a small group.—*Arthur C. Miller, Manhattan, N. Y.*

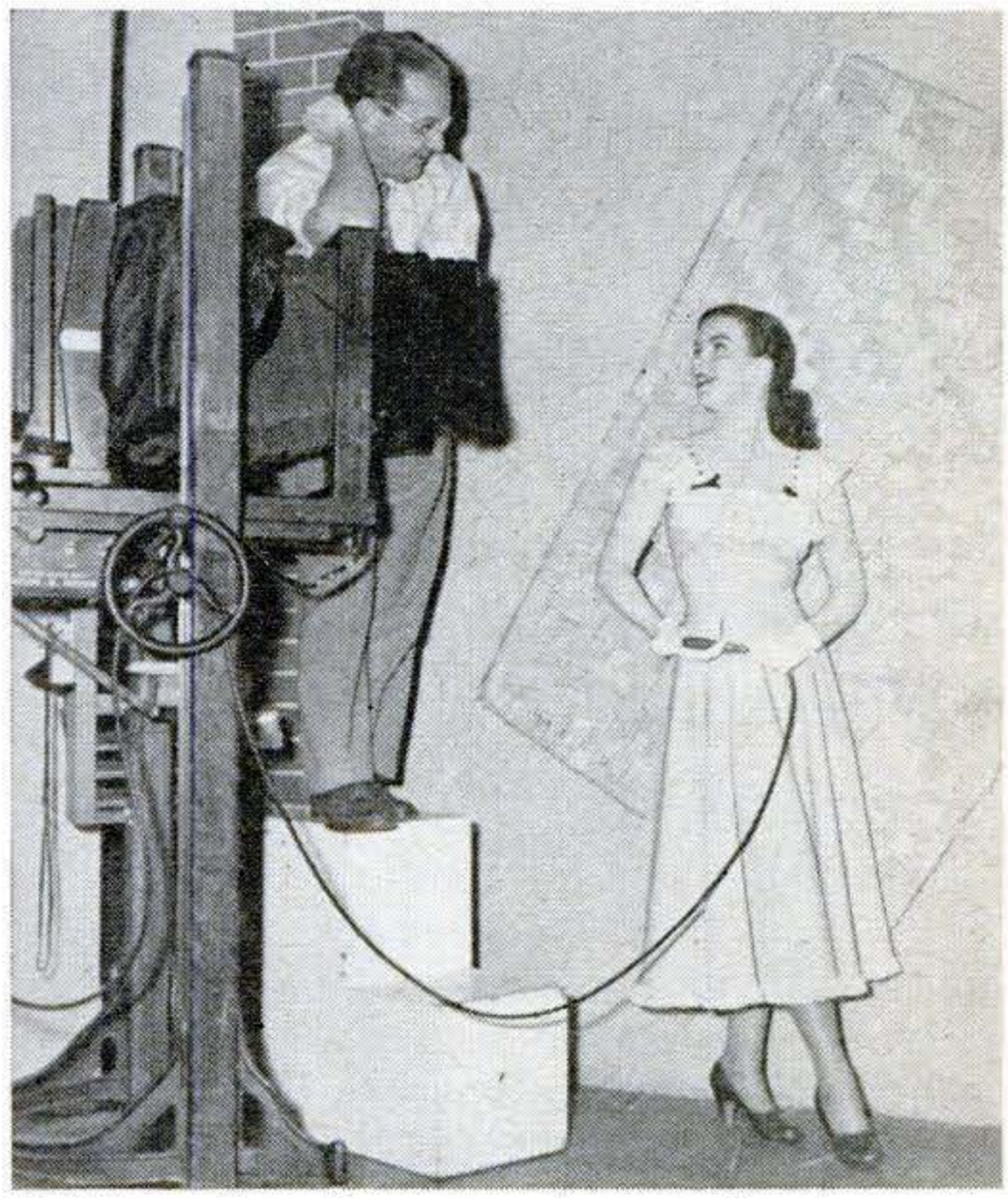


Solder the 6-volt leads to the battery contacts inside the case. A black ring painted on the flashlight lens cuts down light flare.

5347

Remote Control Lets Subjects Snap Themselves

That's a real bomb-release plunger you see in Ray Jones's left hand. It's connected to the camera shutter via wire and a solenoid.



Holding the plunger, subjects take their own portraits. Jones, a Hollywood photographer, has found the device helps a subject relax.

If you don't care for the pictures others take of you, drop in on Ray Jones. Buying a bomb-release plunger, this enterprising Hollywood photographer hooked it up with a solenoid to the shutter release of his portrait camera. Current is supplied by a B battery.

When customers appear, Jones poses them, sets the shutter, and then turns over the plunger with instructions to shoot when their expressions suit themselves.

The camera shutter takes something of a beating, for the subjects keep clicking it. But Jones says he isn't worried about that as long as he gets the relaxed portraits he wants.—*F. Louis Friedman, Hollywood.*

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Three-Pound Radio Is on the Ball

Housed in a cut-down file box, this little personal portable really drags in stations.

By Albert Rowley

HOW much radio can you stuff into a portable, and how small can you make it? POPULAR SCIENCE asked these two questions, and here are my answers. The first is "plenty." The second is that with standard, easily available parts, you can boil it down to a three-pound package 3½" by 5½" by 6".

Smaller sets can be made, but they'll probably offer less radio. Here's a honey of a compromise between size and performance. It gives you a four-tube superhet circuit, good loudspeaker volume, and enough sensitivity to pull in practically everything on the air. In tryouts the signal-grabbing qualities of this midget put several table-model radios to shame.

It's a natural to take along to the ball park—easier to carry than your best girl's handbag. Your favorite sports announcer can feed you the statistics on the game while you watch, and if leather-lunged fans around you get too noisy, all you have to do is plug in the earphone jack and listen in quiet and privacy. And don't worry about having to tote extra batteries to keep the set alive. This model went through two ball games on the same single-cell A supply.

Your first job is to assemble the parts, and that means careful shopping and selection. Chances are the spare-parts box won't be of much help in this case because you have to make sure, before using any part, that no smaller one is available. Be sure to specify ¼-watt fixed resistors, and get the smallest paper tubular condensers you can. They don't have to be rated higher than 200 volts as they won't have anything over 70 volts to cope with. Mica condensers don't have to be any larger than 7/16" by 11/16". You may find a volume control even smaller than

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the one used here, as some new midget units have recently been announced.

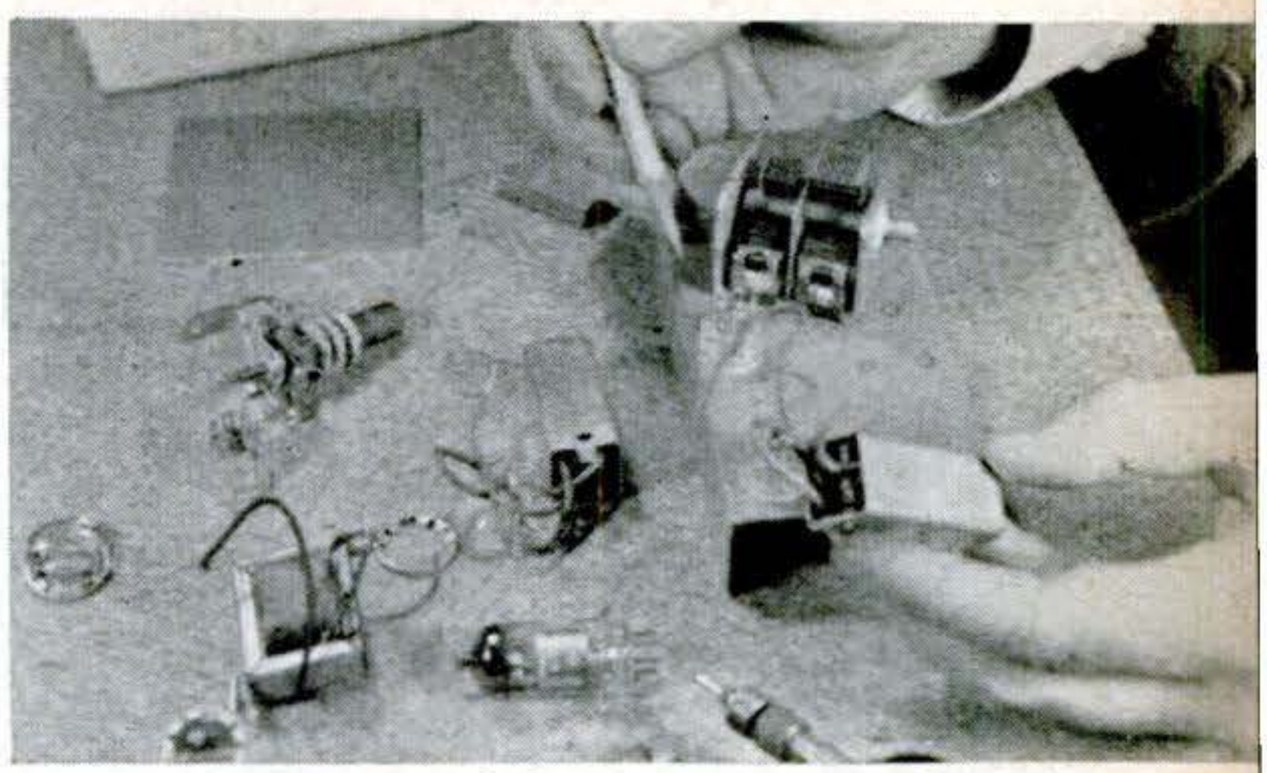
The midget two-gang tuning condenser measures only 1⅝″ behind the panel; this one has a cut-plate section to tune the oscillator of the 1R5 converter tube. Should you be unable to find a midget condenser with an oscillator section, a small standard unit with two equal gangs can be used instead. In this case, however, a padder will have to be inserted in series with the ground lead of the oscillator coil.

The oscillator coil itself should have an adjustable iron core. This makes it easier to align the two sections of the variable condenser. Turn the core about three fourths of the way out of the coil; final adjustment can be made after the set is working.

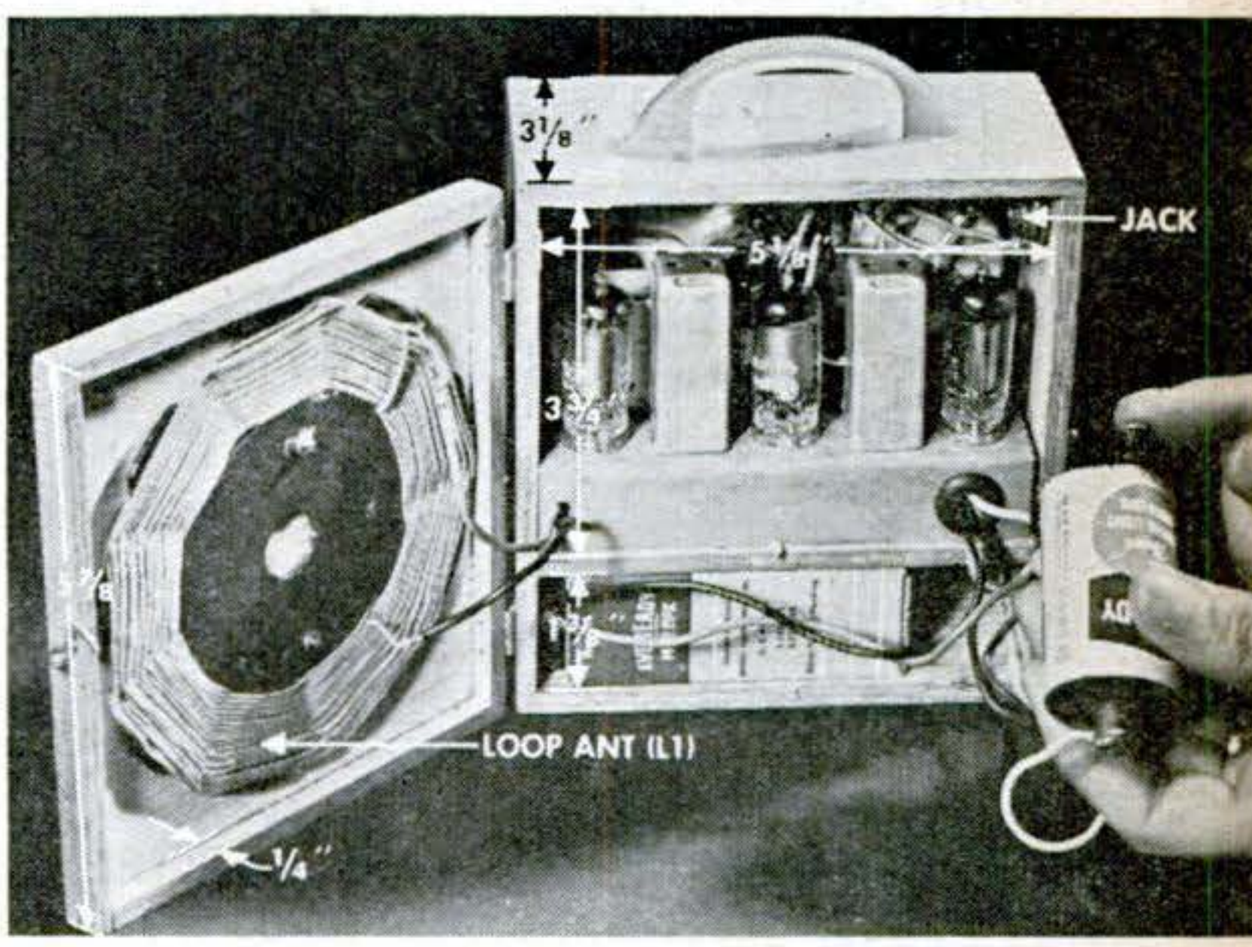
Probably the most important components in terms of size are the intermediate-frequency transformers and the loudspeaker. Your best bet in both cases is to try to pick up replacement parts for commercial personal radios. Surplus permeability-tuned IF transformers also are available in the proper size, and some new IF's are to be had within the ¾″ by ¾″ by 2″ dimensions of the ones I used. Slug-tuned IF's, incidentally, have the additional advantage of broad-tuning, which means that you can align the circuits easily without a signal generator. Those who have built superhets with ordinary IF transformers know what this can mean with limited equipment. Should you settle on surplus transformers, make sure that they are designed for the 456-kc. intermediate frequency.

Both the output transformer and the speaker are replacement parts for midget sets. The speaker is of an oval shape, and its cone measures only 1¾″ by 2½″. It's rated for 1 watt of output, which is ample for the set.

When you get through with your purchases at the radio store, drop into a stationery store and buy the cabinet. Just ask for an ordinary wooden file box of the extra-deep (6″) type, made to hold 500 3″ by 5″ cards. Don't use a metal case if you hope to get reception with a loop antenna. The old cover is glued down and a new one sawed off near the back. Make another cut at the same time to reduce the over-all height of the box to 3⅝″. A ¼″ plywood shelf is glued and nailed in 1⅜″ above the bottom to provide a base for the chassis and a compartment for the batteries. The top of the case becomes the front of the radio.



Make trial layouts of the chassis-mounted components before you drill all of the mounting holes. The chassis area is only 2¾″ by 5″.



A grid cap snaps on the positive contact of the single A cell. Slid between cardboard tube and case, a split paper clip takes the other lead.

These photos show the chassis layout used; some of the parts can be shifted around to suit your own design, but for short leads try to maintain the relative positions shown. Cut a piece of sheet aluminum 4½″ by 5″ and bend a ⅞″ leg along each of the shorter sides. The resulting chassis will measure 2¾″ by 5″. Since all the larger parts except the oscillator coil go on top of the chassis, this is the side to consider most carefully. Spread the parts out as shown in one photo, and mark the position of each one carefully. The two-gang tuning condenser, four miniature-tube sockets, two IF transformers, volume control and switch, output transformer, small PM speaker, and the plate by-pass condenser for the 1S4 go above the chassis; all except the by-pass condenser need separate house room on the small plate.

While you have to allow room for the volume control and switch, you won't be able to mount them on the chassis. For this you

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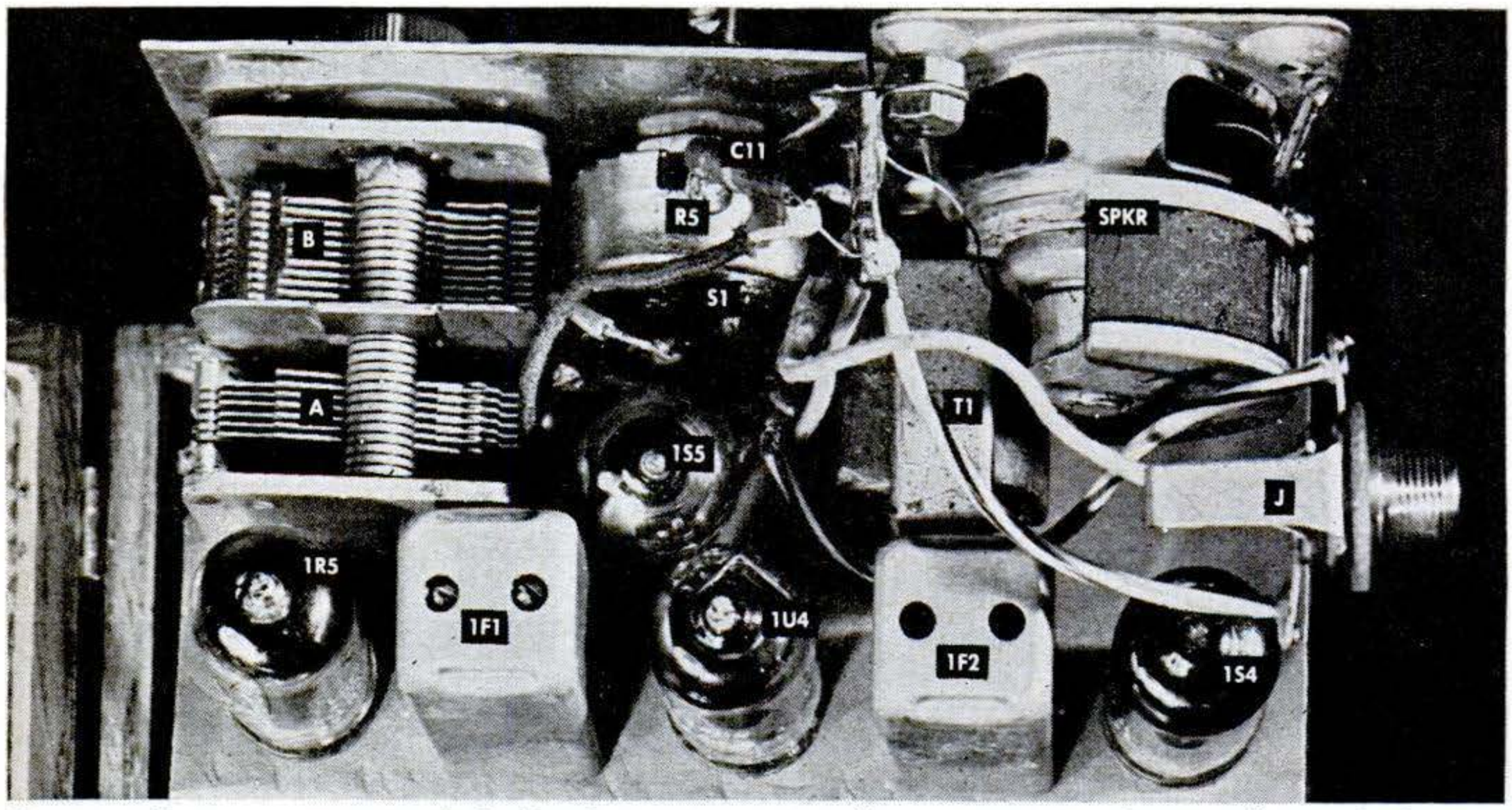


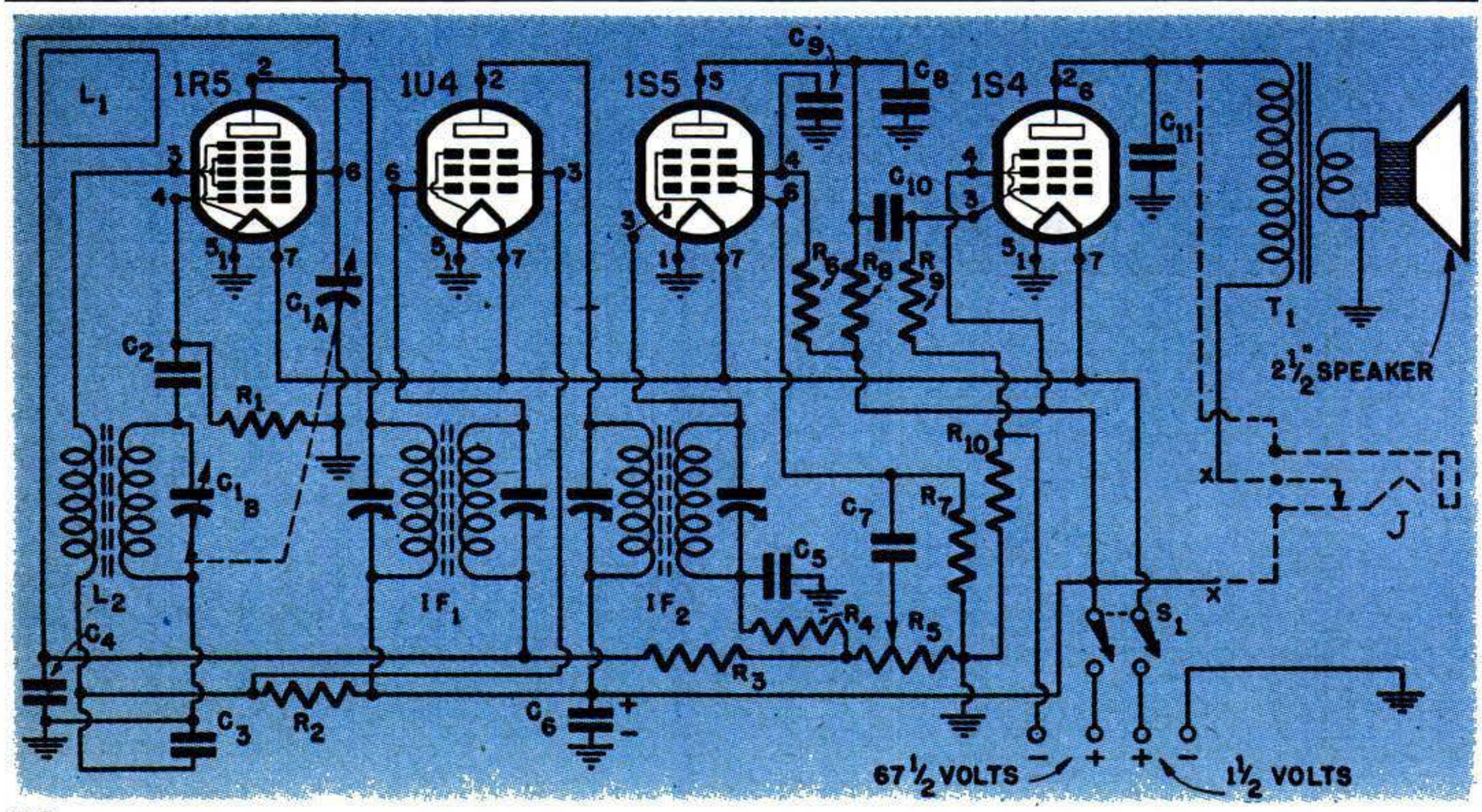
Compact but not overcrowded, the chassis top has little waste space. Note the midget output transformer next to the speaker, which is a miniature 2½" PM that has an oval-shaped cone.

need a front panel—a 3" aluminum square bolted to the chassis. Drill a hole through the same panel to clear the shaft of the tuning condenser.

Leave the wiring of the loop antenna and the batteries for the last. Begin with the connections to the 1R5 converter stage, then go on to the IF stage and the 1U4 RF pentode. Next make the connections to the diode of the 1S5 detector. Instead of follow-

PARTS LIST

All fixed resistors ¼ watt insulated carbon.
R1: 220,000 ohms.
R2: 10,000 ohms.
R3, R6: 3.3 meg.
R4: 82,000 ohms.
R5: 1-meg. volume control with DPST switch (S1).
R7: 10 meg.
R8: 1 meg.
R9: 2.2 meg.
R10: 200 ohms (This value is critical within 5%).
All paper condensers 200 volts.
C1 A, B: Midget two-gang tuning condenser with cut-plate oscillator section.
C2, C5, C8: .0001-mfd. mica.
C3, C4, C9: .01-mfd. paper.
C6: 8-mfd., 150-volt electrolytic.
C7, C10, C11: .005-mfd. paper.
L1: Loop antenna.
L2: Adjustable iron-core OSC. coil.
1F1, 1F2: Midget intermediate-frequency transformers, preferably permeability tuned.
S1: DPST switch on R5.
J: Normally closed phone jack.
PM speaker, 2½" oval cone; tubes, batteries (1 67½-volt B and 1 1½-volt A); four miniature-tube sockets; aluminum chassis and panel, misc. hardware.



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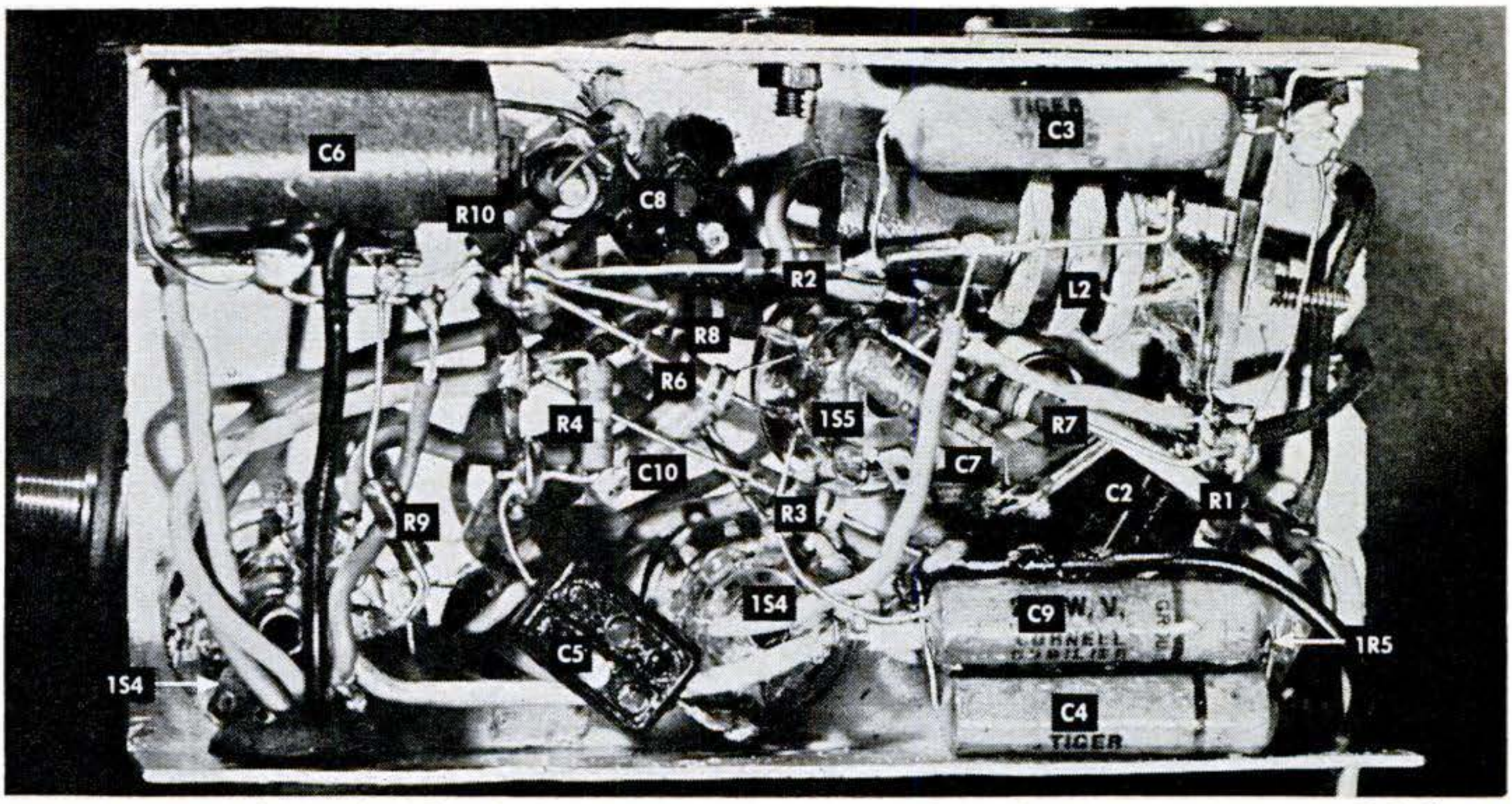


No rat's nest, the underside of the chassis is no tougher to wire than many larger sets. However, a planned wiring sequence will help to prevent you from getting badly in your own way.

ing the usual sequence right through, it may be better to stop at this point and commence wiring the speaker. Work backward from here to the pentode portion of the 1S5. The network of resistors and condensers that go to the grid, screen and plate of this tube and to the grid of the 1S4 output tube are the last of the small parts to be connected. This wiring sequence isn't essential, but it will help you find soldering room.

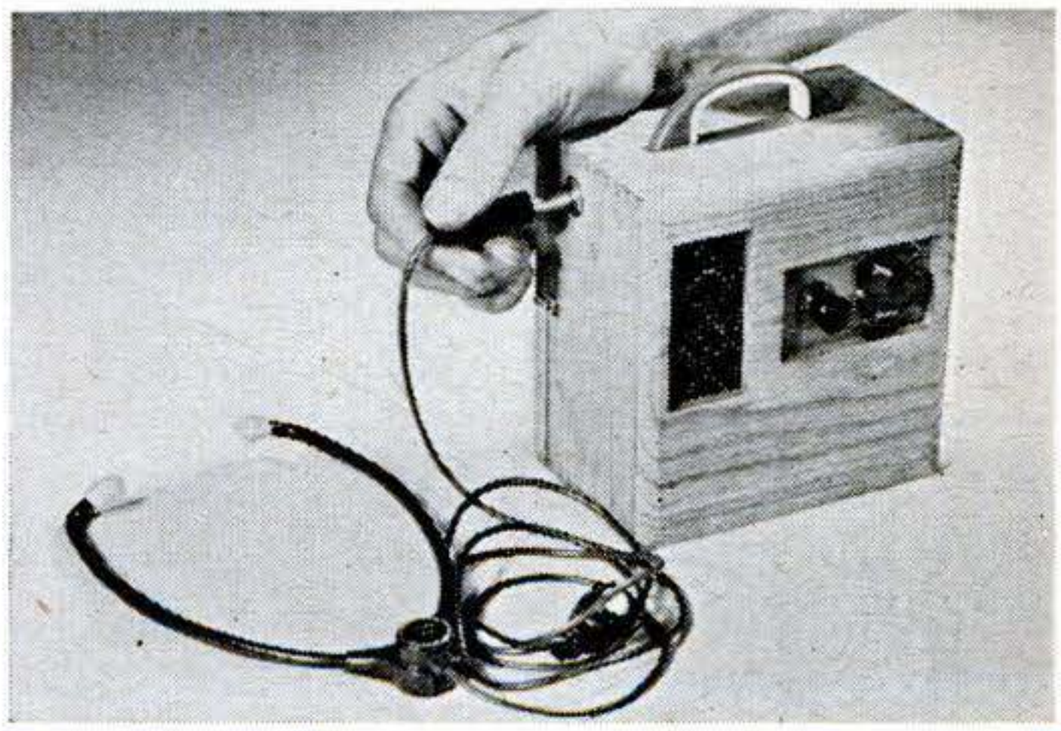
Headphones aren't necessary with this set but there are times when you will find them handy, so an optional phone jack is shown in the diagram. The jack to use is a normally closed unit that completes the loudspeaker circuit when the phones are not being used. Plugging in the phones automatically breaks the connection to the speaker.

For noisy spots, weak stations, or private listening, earphones are nice extra equipment. But if you should decide to pass them by, all you have to do is omit the portion shown by broken lines and connect the two wires marked "x" in the schematic drawing.

Drill a hole through the rear flange of the chassis and insert a rubber grommet. Through it you can bring four leads—preferably color coded—to the batteries. The coding is only to help you until the connections are made, since two of the leads are soldered to a standard, polarized clip that is used on 67½-volt batteries. The wire going to the positive (center) terminal of the flashlight cell is soldered to a grid-cap clip. For the negative connection a paper fastener is soldered to the lead and inserted between the metal shell of the battery and its cardboard sleeve. Cells of the sleeveless type will require a different connection.

When the chassis is completely wired, connect the batteries and loop antenna and tune the circuits for maximum volume and sensitivity. Start with the secondary of 1F2, and work back to the primary of 1F1. Bring in a station at the high end of the dial (with the tuning-condenser plates out of mesh) and adjust the trimmers on the side of the variable condenser. Take care of the oscillator trimmer first.

You'll find that you can strengthen weak stations a little by opening the back cover and allowing the antenna to swing about two or three inches away from the metal chassis. END



Plugging in the phones automatically cuts off the speaker. Phones are good in noisy locations.

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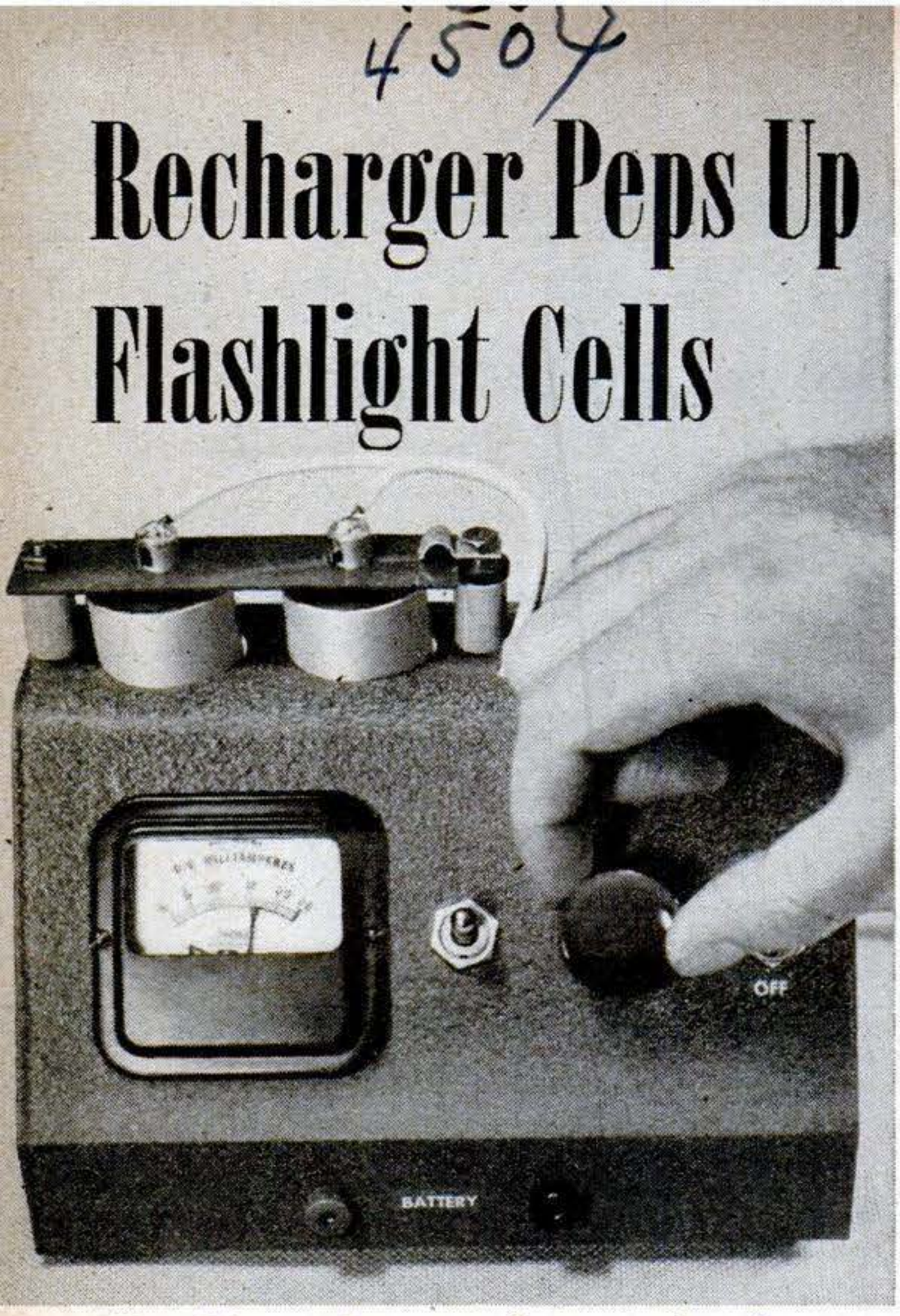
Recharger Peps Up Flashlight Cells



New life can be pumped into weak cells an average of fifteen times before they are worn out.

CAN you really recharge dry cells? And does it pay? The answers are, respectively, an emphatic yes and a temperate maybe.

To take the second point first, it would plainly not be sensible to lay out the $9 or $10 for the parts of this charger if you only use a handful of 10-cent cells a year. But if your home keeps three or four flashlights in use, or if your portable radio or bike lights show a hungry appetite for dry cells, this charger may indeed be worth while. Heavy users of batteries—press photographers, theater managers, repairmen, persons using hearing aids—may find that a charger can pay for itself fast.

In figuring the economics of it, don't be put off by the cost figure quoted. The device shown was built entirely from store-bought parts, and assembled with an eye to looks. If you have a fair-sized scrap box, and if you can dispense with a slope-front cabinet, you can probably halve the cost at least.

The charger pictured works off a 115-volt AC line and handles any size dry cell, flashlight cell, and radio A or C battery up to 6 volts. It is *not* designed for multiple-cell B batteries of comparatively high voltage.

For a transformer I used a standard universal output transformer (a Stancor A-3852). It's considerably cheaper than a 10-volt filament transformer and serves just as well, delivering 9.5 volts between the Nos. 3 and 4 lugs on the secondary or voice-coil winding. The primary is centertapped, and the input is between either lead and the centertap, the other lead being cut back and taped.

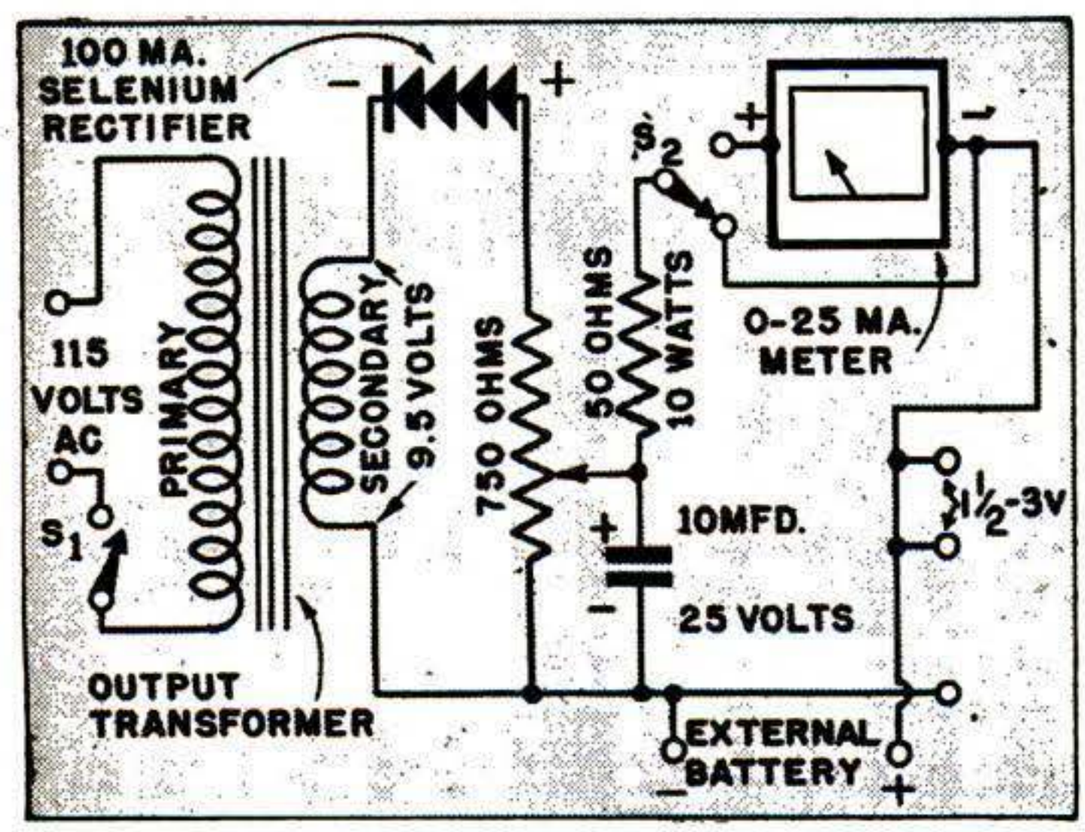
Many other transformers will do, of course, but don't try to use one of the smaller doorbell types. The chances are that the voltage after rectification will be insufficient.

The rest of the components are also commonplace. A small 100-ma. selenium rectifier of the kind found in many new AC-DC radios is used, and costs less than a dollar. With 9.5 volts input, the rectified output is about 6 volts without load.

Adjustment of the charging rate, which must be varied according to the size of the cell, is accomplished through the 750-ohm wire-wound potentiometer. A cheap milliammeter, costing about $1.50, can be considered a must to allow this adjustment. Less essential but still highly convenient is a low-reading DC voltmeter to measure cells before and after charging.

Assemble the circuit in any convenient chassis, cabinet, or box, being careful to follow polarity of the leads. In the charger shown I punched two large holes in the top and rigged up a mounting to take two D-size cells at once, using a pair of grid caps as clips for the positive leads. A set of jacks and plugs permits running wires to other dry cells to be charged.

Considerable experimenting with recharging dry cells stands back of the following rules: Don't try to recharge cells with bulged or corroded cases. Don't try to recharge any that have been out of use for a year or more. Don't try to recharge cells that have



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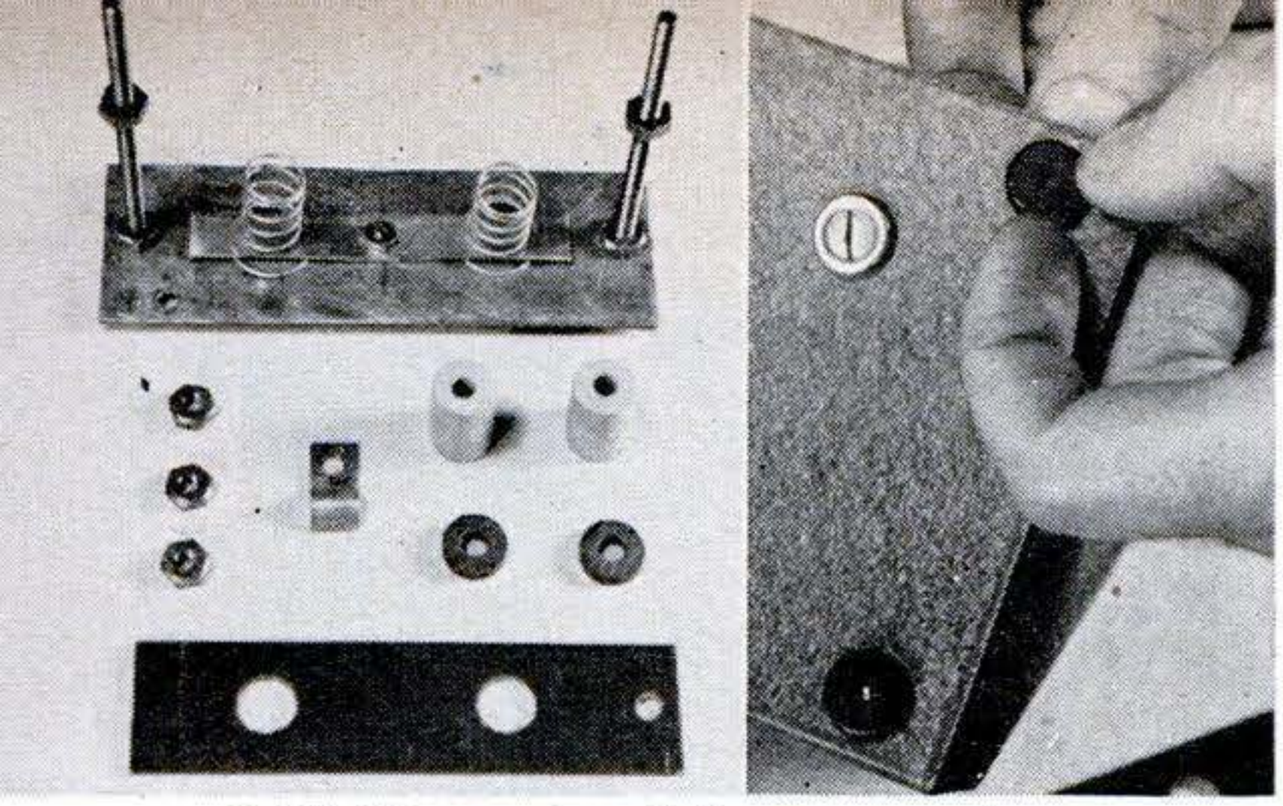
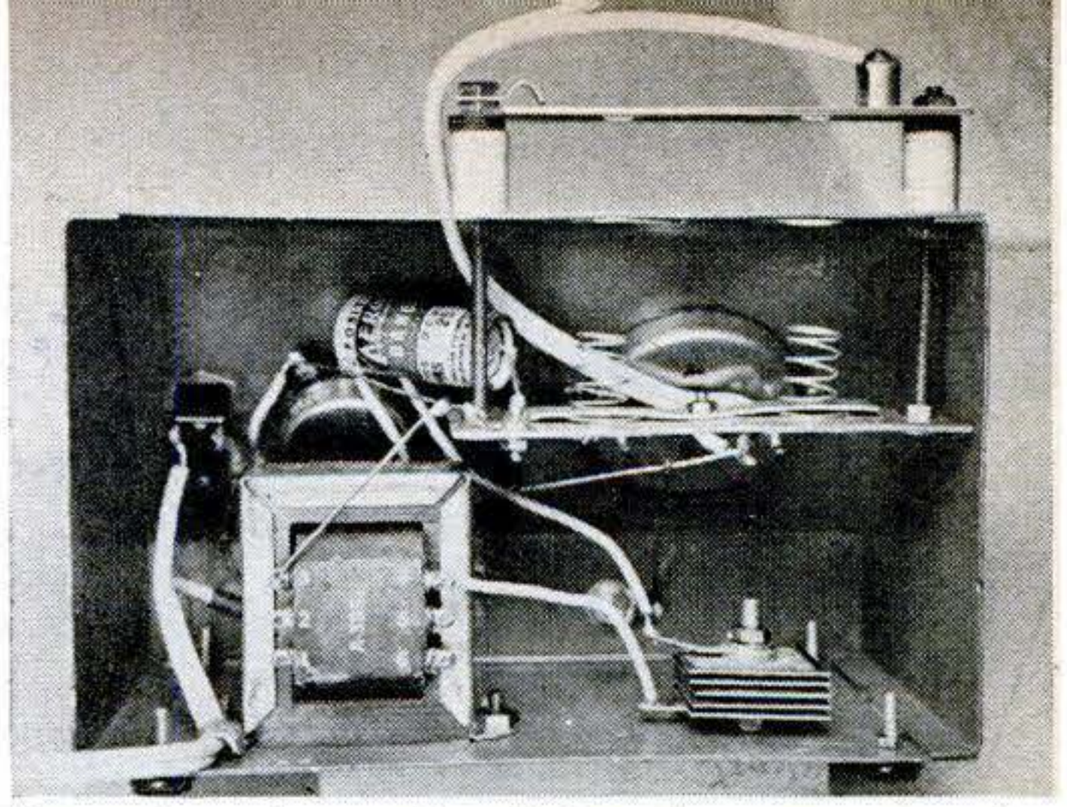


Stiff fiber strips, left, are spaced out on two long 8-32 screws to hold D-size cells that are charged. Right, cushioned feet hold the cabinet.



Rear view shows simplicity of construction. An inexpensive output transformer supplies power to the small selenium rectifier shown at right.

dropped below about two thirds of their original voltage. Don't put a recharged cell into immediate use, but let it rest for a day first to lose any temporary overvoltage.

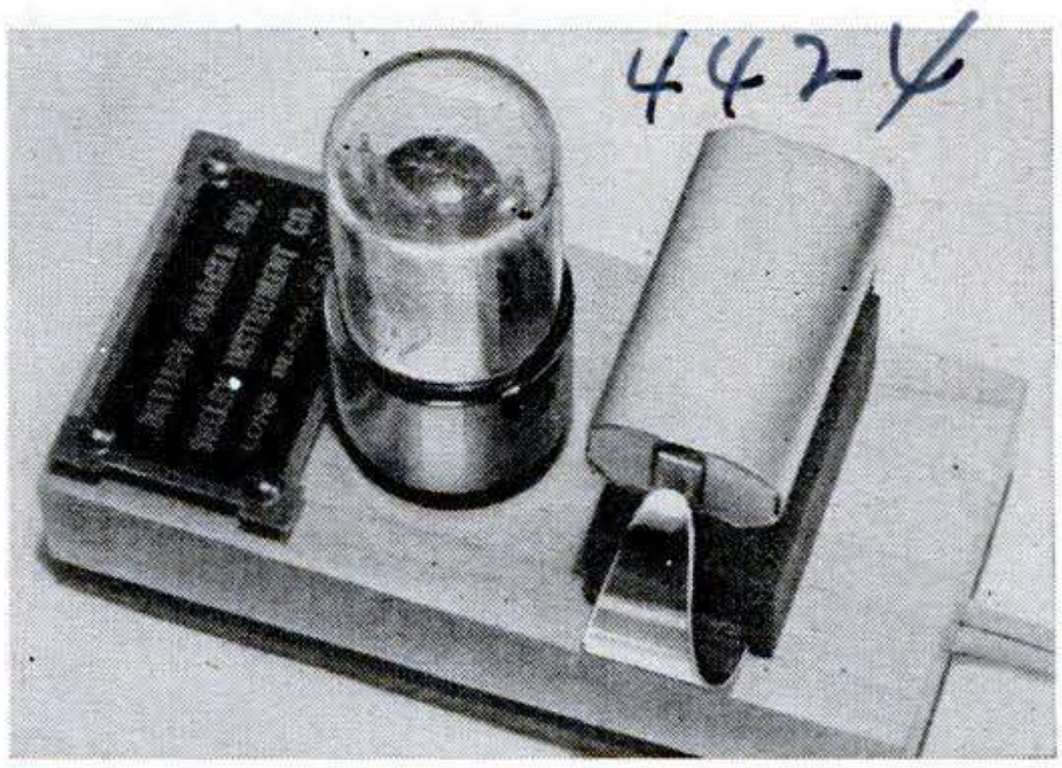
Unlike storage batteries, dry cells seem to have a more or less fixed charging time—around 22 hours. After approximately this period on charge the current flow goes up sharply and the cell should be removed. Here is the preferred charging rate for different cells:

SIZE OF CELL	CURRENT IN MA.
No. 6 dry cell	15–25
D cell	10–15
C cell	7–15
AA cell (penlite)	5–10

One rule to keep in mind is to hold the current down so that the cells never feel warm to the touch.

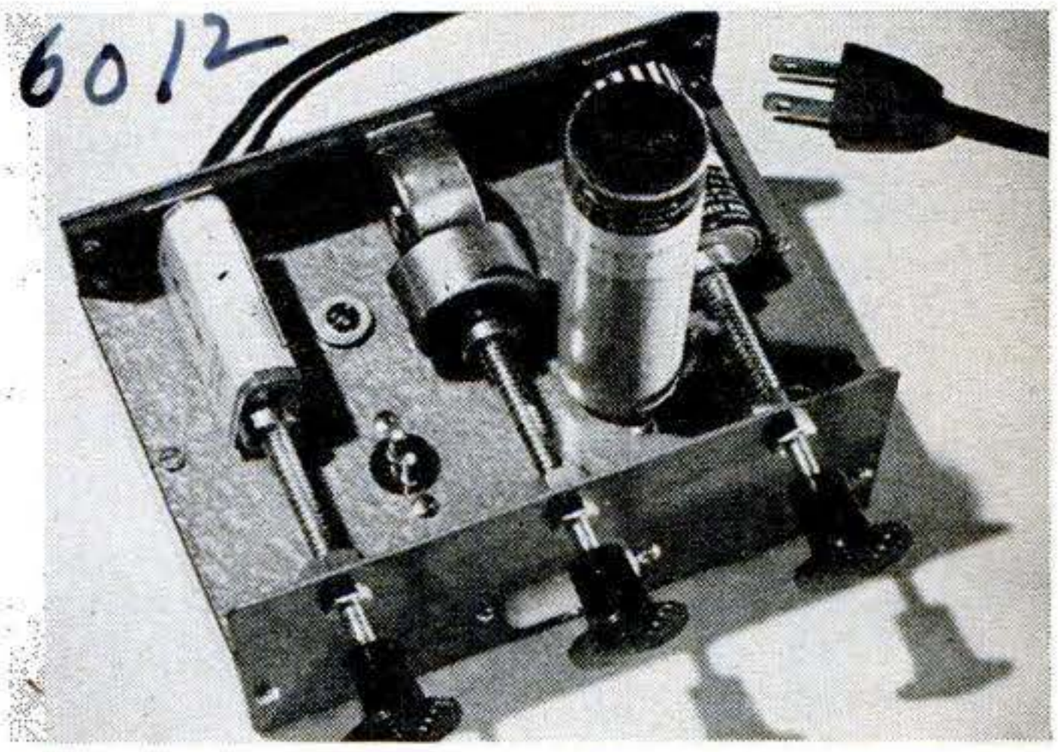
You'll find a considerable variation from cell to cell. Some will come up nicely; others of the same make, age, and previous condition of servitude will be reluctant performers. Occasionally one will respond poorly the first few times it's charged but will later behave better, taking repeated charges. A cell in good condition can generally be recharged fifteen times or more.

If you're interested in theory, it has been found experimentally that discharged cells contain manganese oxide in the depolarizer. Since this substance is originally manganese dioxide, it seems likely that one result of discharging is to convert this dioxide into monoxide. The process is reversible; recharging seems to convert it back to dioxide, thus revitalizing the cell.—*Arthur C. Miller, Manhattan, N. Y.*



Hearing-Aid B's Recharged

Users of this device for recharging hearing-aid B batteries charge one battery while using the other. Each morning the batteries are exchanged. Made by the Shelby Instrument Co., of Long Beach, Calif., the charger retails for $10. The maker claims it gives up to 75 percent longer battery life, and uses about 5 cents worth of electricity a month.



Hearing-Aid A's Recharged

Able to handle any type of A batteries used in hearing aids, this charger is said to cut A battery costs from $5 to 50 cents a month. Made by Mecon Products, Inc., of Los Angeles, and selling for $12.95, it draws about 3 cents worth of current a month. Given proper care, each battery can be charged 10 times or more, the maker asserts,

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NEWS IN ELECTRONICS

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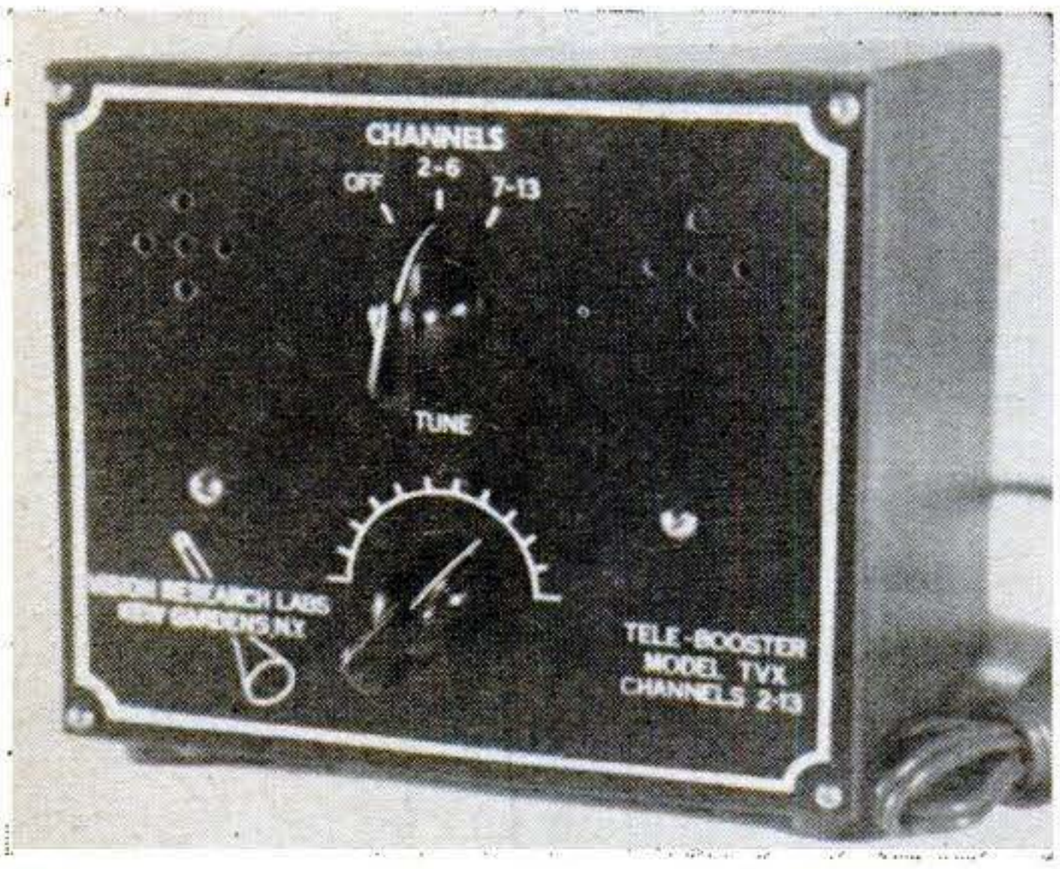
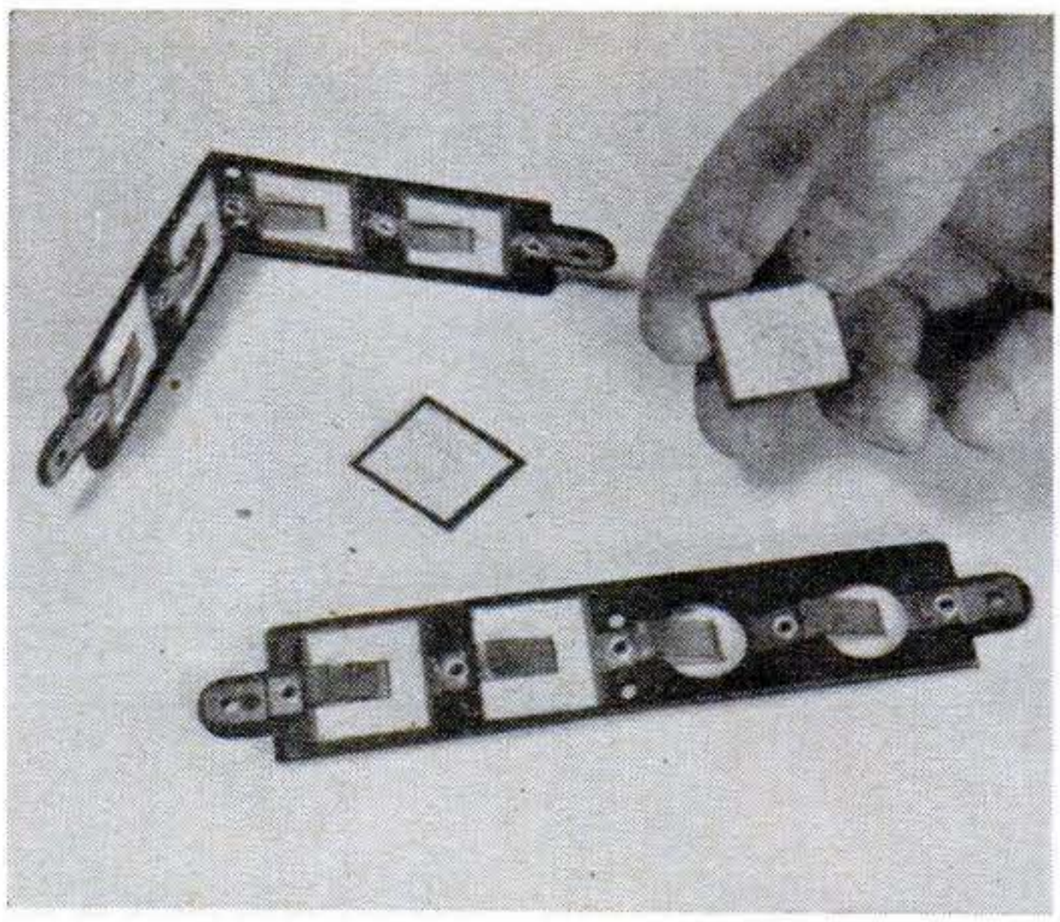


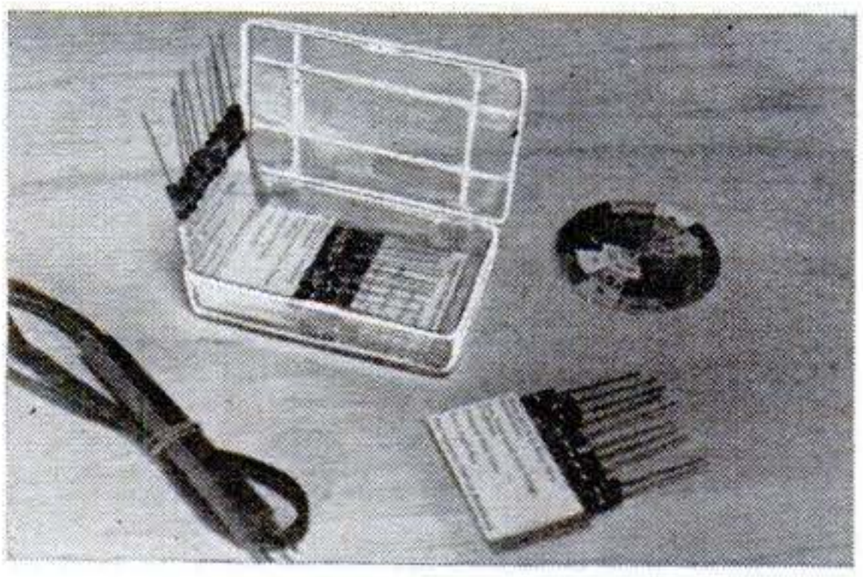
Pre-Amp Boosts TV Pickup. Television-set owners who are receiving poor video signals due either to location or set characteristics may benefit from the use of a wide-band pre-amplifier. The model above uses two 6AK5 tubes and has a selenium rectifier. In some areas it may eliminate the need for an outdoor antenna. Vision Research Laboratories, Richmond Hill, N. Y., makes the booster. It sells for about $27.



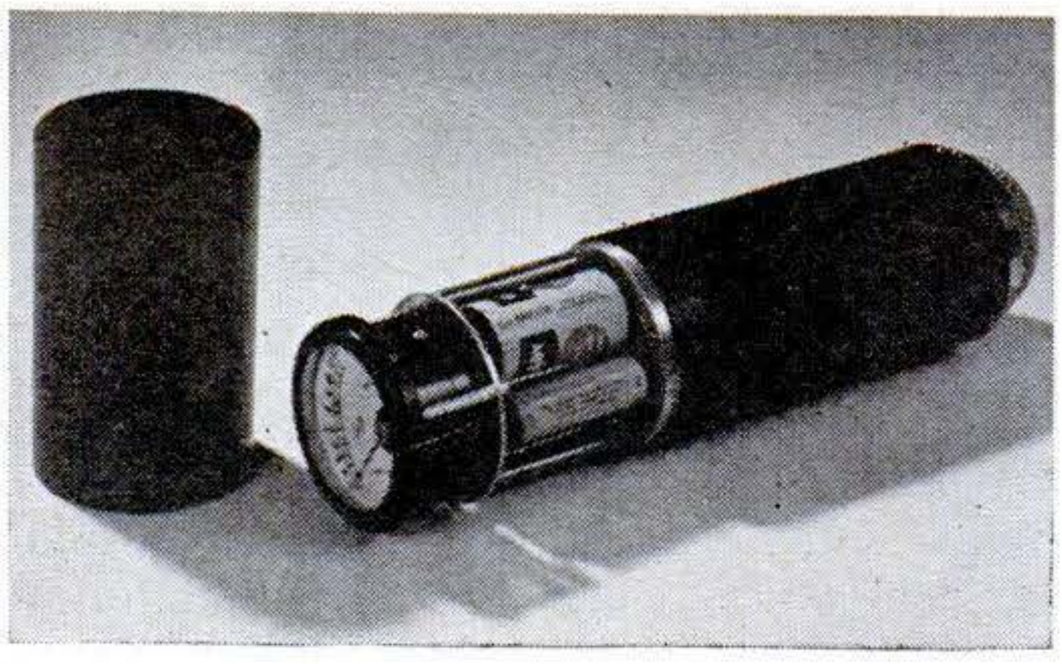
Strip Rectifiers Save Space. Selenium rectifiers are now being manufactured in wafer-thin strips consisting of four rectifying elements. They can be mounted on the wall of a chassis or bent around corners. Strip construction is said to speed heat dissipation, making for cooler operation, and the reduced number of elements (four instead of the usual five or six) cuts voltage drop across the rectifier. Where higher outputs are needed, the half-wave units can be combined in conventional full-wave and voltage-doubler circuits.

5412

Resistors Show Up in Plastic. A kit of 40 assorted carbon resistors is marketed by Continental Carbon Inc., Cleveland, in a clear plastic box. The transparent case helps the experimenter or serviceman keep tabs on the sizes still on hand and also makes any particular item easy to locate. The hinged-cover boxes can, of course, be reused as small-parts containers. Various values from 100 ohms to 10 meg. are included in the standard kits.



Sound-Level Meter. A pocket-size noise meter enables engineers and technicians to check locations and installations where noise level is a factor. Said to be as accurate as meters weighing 20 to 30 times as much, this miniature, 2-lb. device should help in the placement of microphones and loudspeakers for public-address systems, intercoms, and the like. Sounds picked up by the microphone in the head of the instrument are converted into readings on a decibel meter at the base. Hermon Hosmer Scott, Inc., Cambridge, Mass., is the maker.



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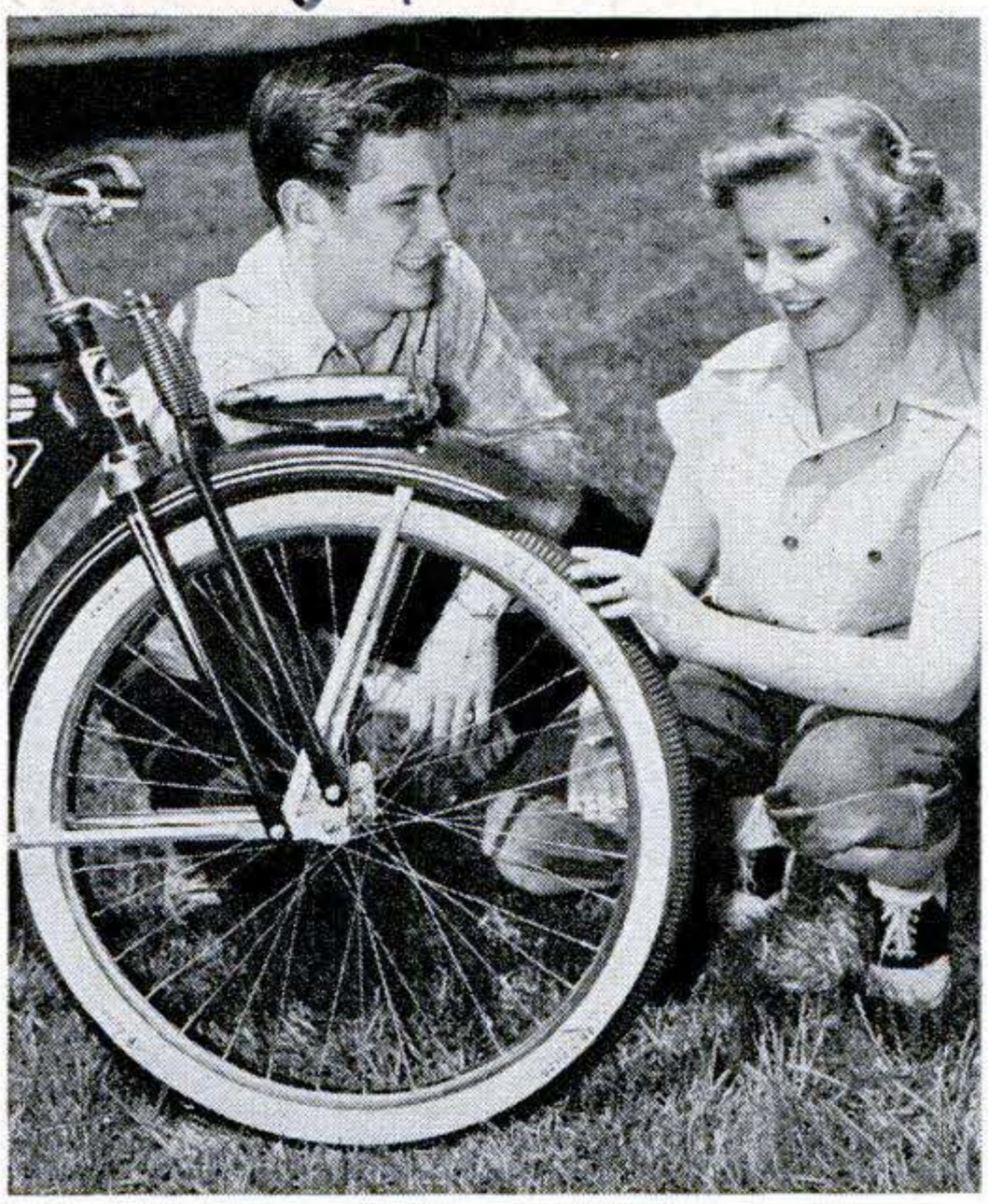
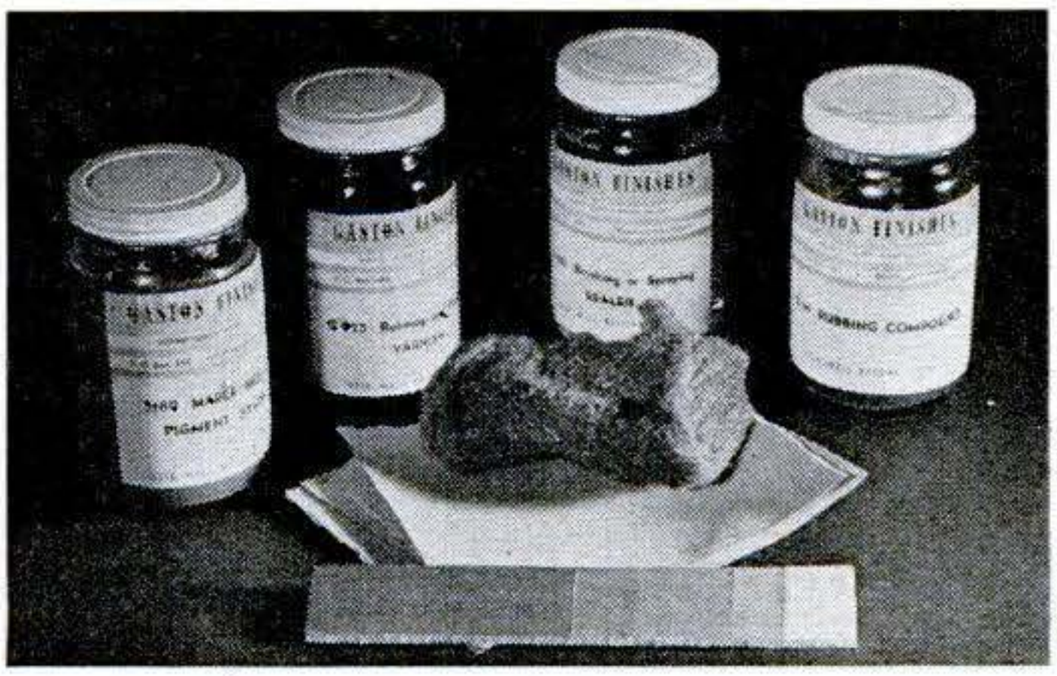


Rayon Bike Tire Announced

A NEW white-sidewall bicycle tire, using rayon instead of conventional fabrics, is announced by the Firestone Tire and Rubber Co., Akron, Ohio. According to Firestone engineers, tests show it has twice the usual strength to resist impacts and bruises, and that rayon doubles the mileage life of the tire.



Wood Finish Comes in Kit Form

WOOD-FINISHING kits, containing all necessary materials and step-by-step instructions, are offered to craftsmen by Gaston Finishes, Bloomington, Ind. Each kit includes stain, filler, sealer, and lacquer, varnish, or enamel in various colors. Also included is a wood panel showing each operation from the raw wood to the rubbed finish. Printed instructions correspond to the steps on the panel. Each package contains the proper grade of sandpaper and steel wool.

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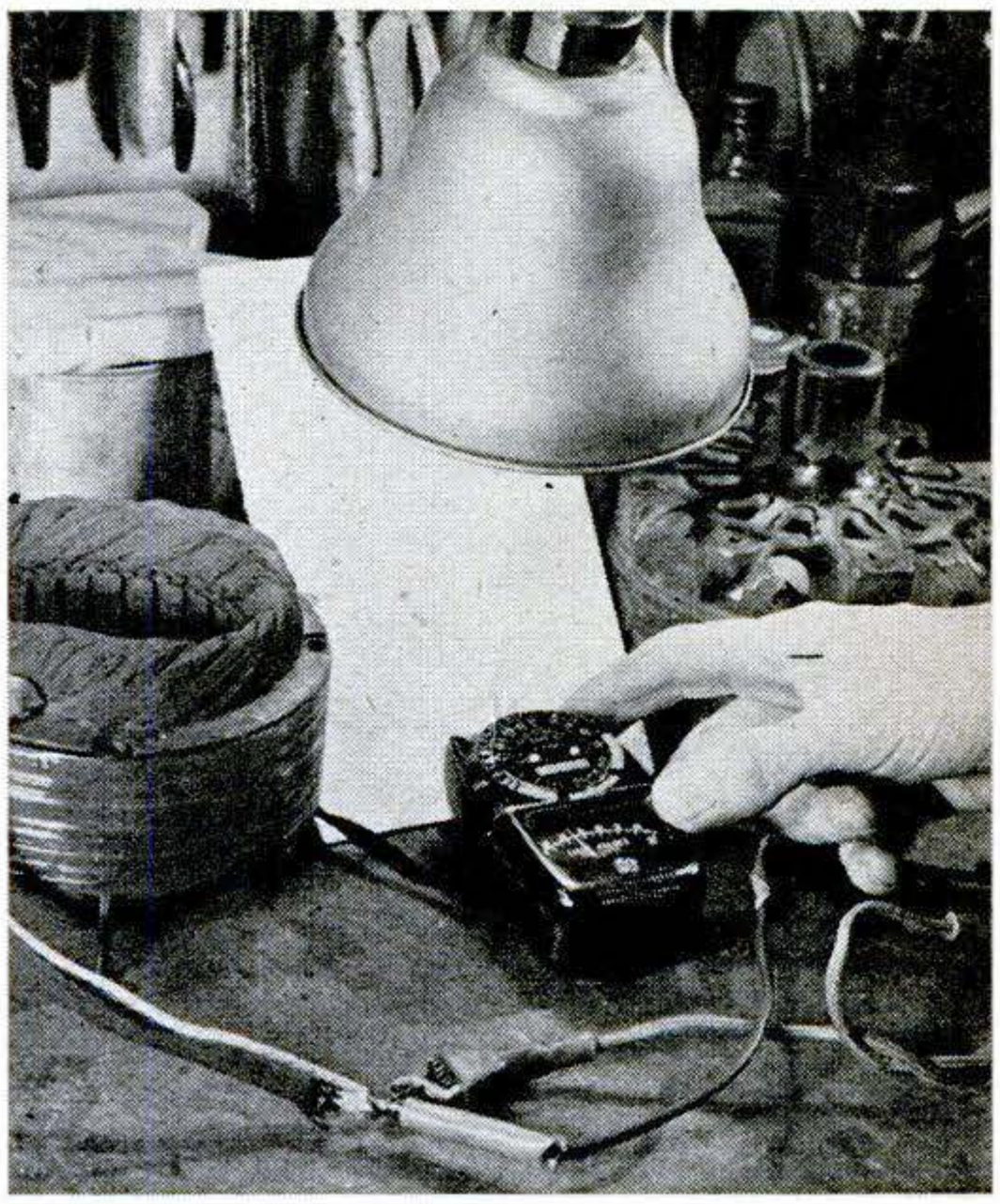
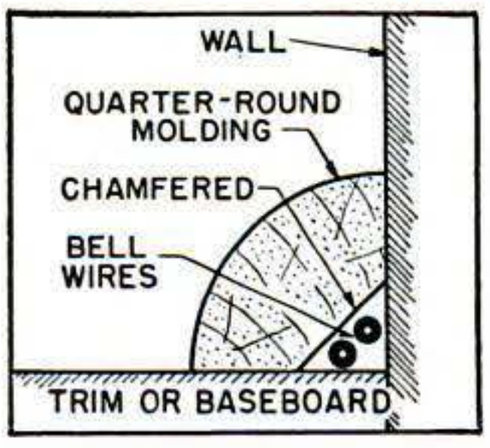


Photo Meter Checks Circuits

PHOTO-ELECTRIC exposure meters may be used to make rough comparison tests of electrical circuits. In the above photo, the meter is being used to check the relative resistance in the windings of a fan motor. The winding is connected to a 115-volt outlet through a 60-watt lamp. A light-colored card reflects light from the lamp to the meter. With the motor coils shorted out, the distance between the lamp and reflector is adjusted until the meter hand reaches the center of the scale. Then the coils are cut into the circuit one at a time and the position of the meter hand noted. By comparing the various readings, an idea of the motor coil resistances can be obtained. A shorted winding will produce a reading near that of the lamp at full brilliancy. The meter should not be moved between readings.—*Walter E. Burton, Akron, Ohio.*

Quarter-Round Conceals Wires



As SHOWN in the sketch at left, low-voltage bell wires may be concealed behind quarter-round molding. The back of the molding must be chamfered to make room for the wires. Then the molding is nailed or even glued in place. At corners, the molding can be mitered.

5086

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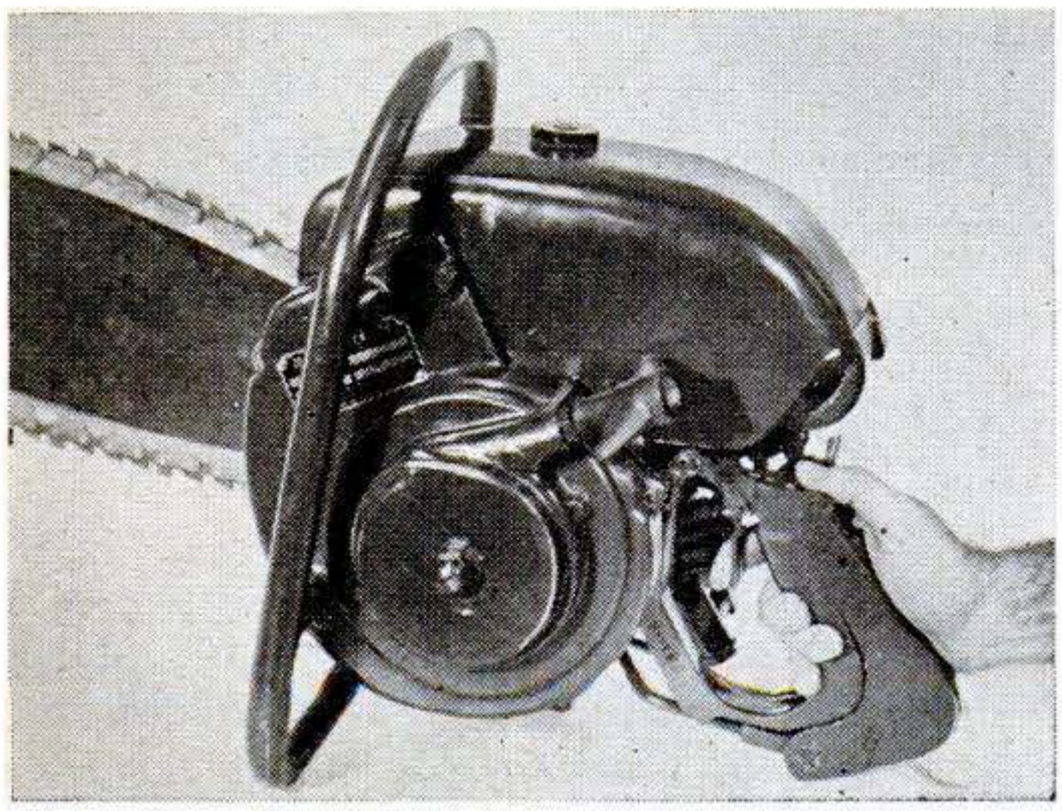
6004

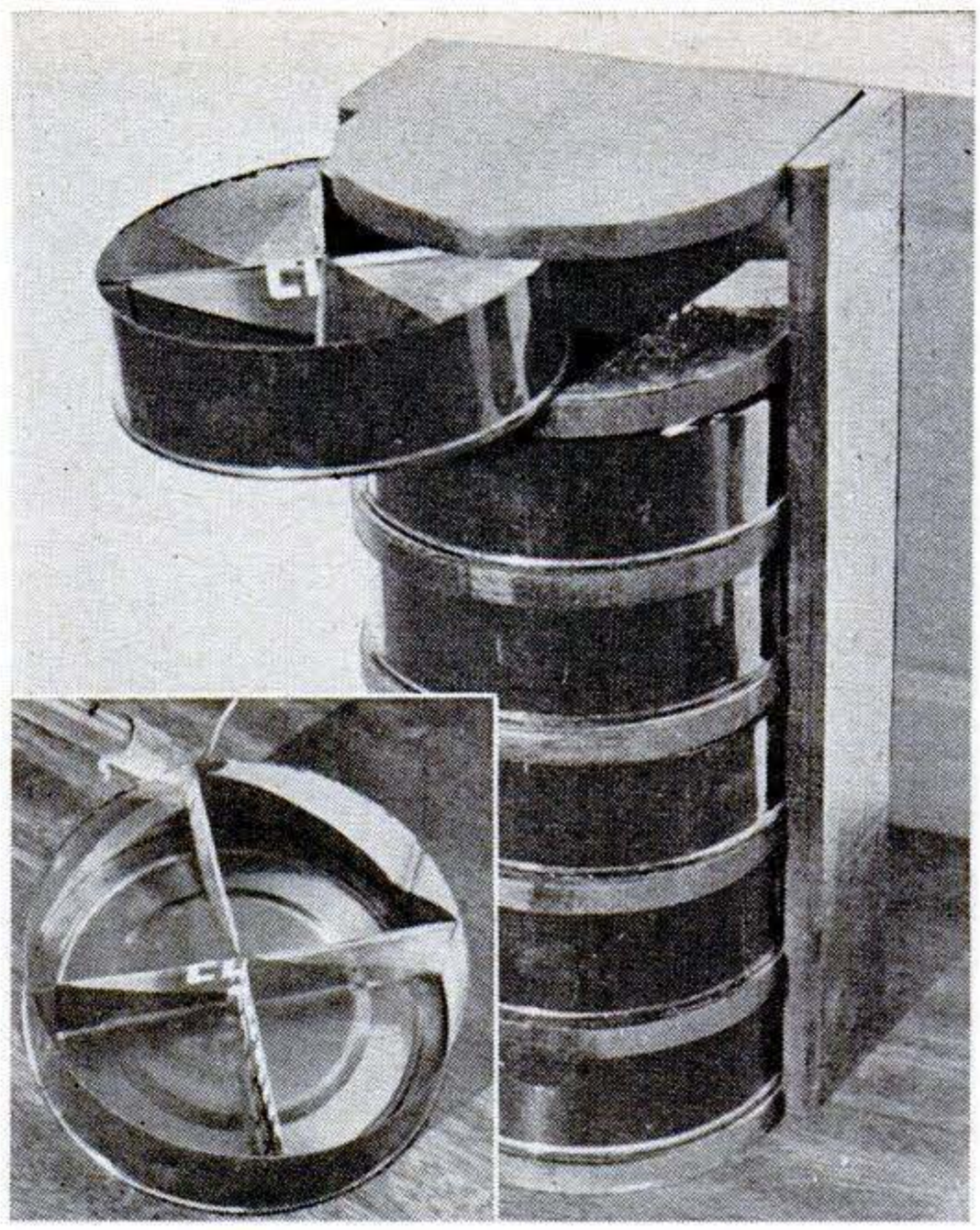
New Chain Saw Is Fast Cutter

LIGHTNESS and power are combined in this new Disston chain saw, which is designed specifically for one-man operation. Weighing only 37 lb. dry, it has a 3½-hp. engine and a blade that extends 18″.

Intended for use in felling, bucking, and limbing, the saw operates equally well right side up, on its side, inverted, and on end. The one-cylinder, two-cycle engine has a clutch, muffler, air cleaner, and sealed magneto system. Starting is by means of a self-rewinding, permanently attached cable.

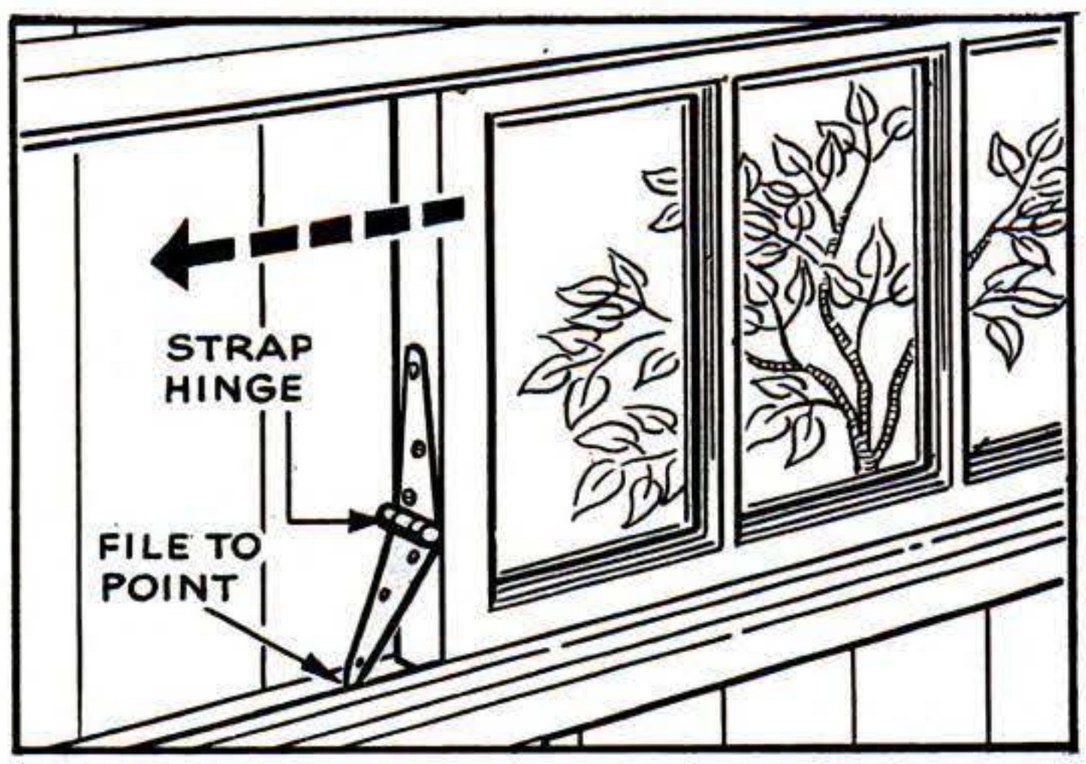
As shown below, engine controls are centralized for safety around a pistol-grip handle. List price of the saw is $389.50.





Coffee Cans Make Parts Rack

A COMPACT cabinet for storing small parts by the workbench may be made from a few 1-lb. coffee cans and some scraps of ⅜″ plywood. Cut off the cans 2″ above the base, saving the scrap for use as compartment separators. The latter are trimmed to size and soldered in place. Seven half-round, half-rectangular pieces of plywood, spaced by 2″ pieces and side strips, form the cabinet itself.—*W. H. Greenfield, Reno, Nev.*



Hinge Locks Sliding Window

AUTOMATIC locking of the horizontally sliding type of window often found in summer camps can be achieved with a common strap hinge. The end of one leaf is ground or filed to a sharp point, and the other leaf is screwed to the side of the window.—*Marion L. Rhodes, Knightstown, Ind.*

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7240 8

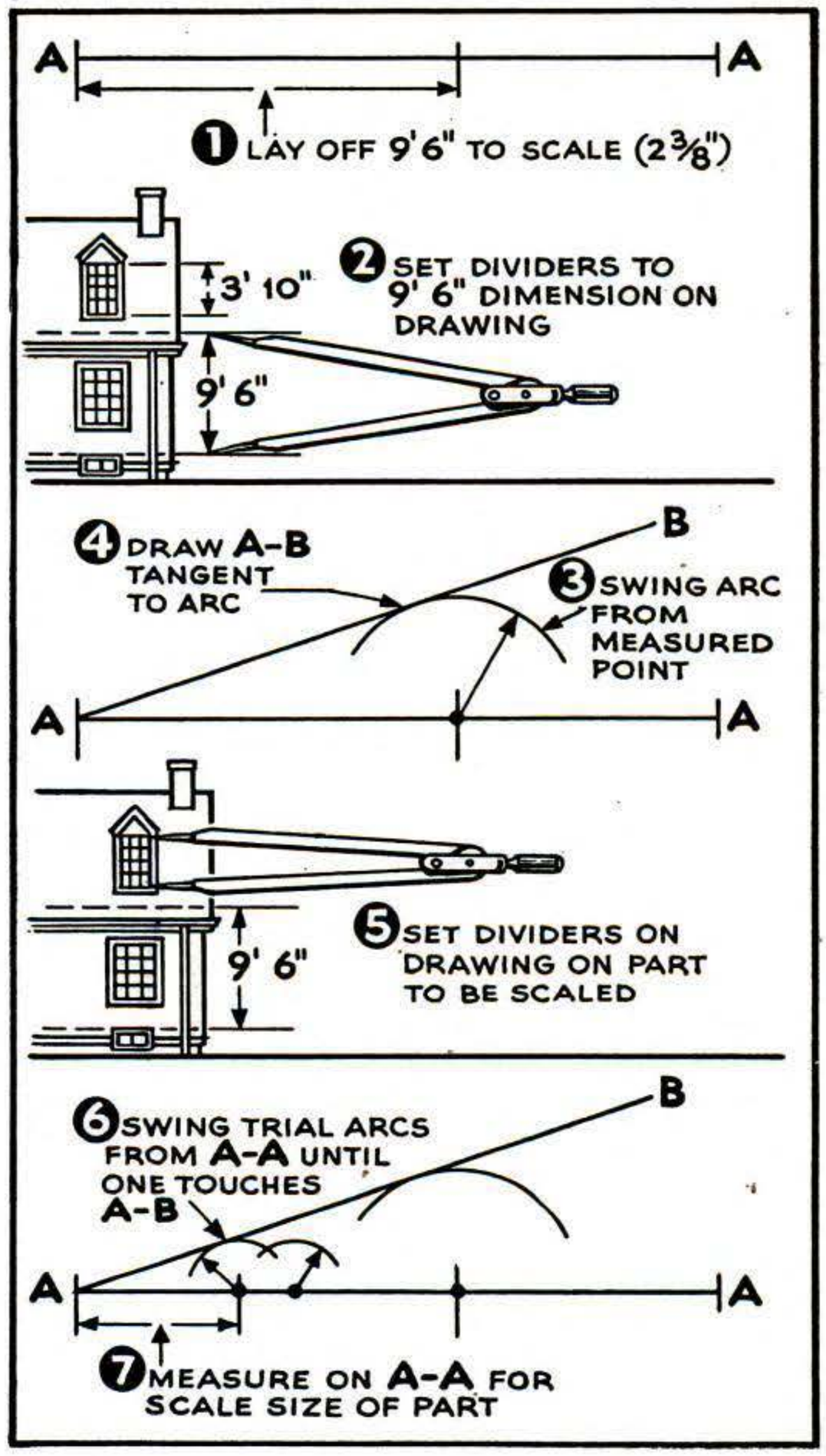
Arc Method of Finding Scale Dimensions Cuts Mathematics

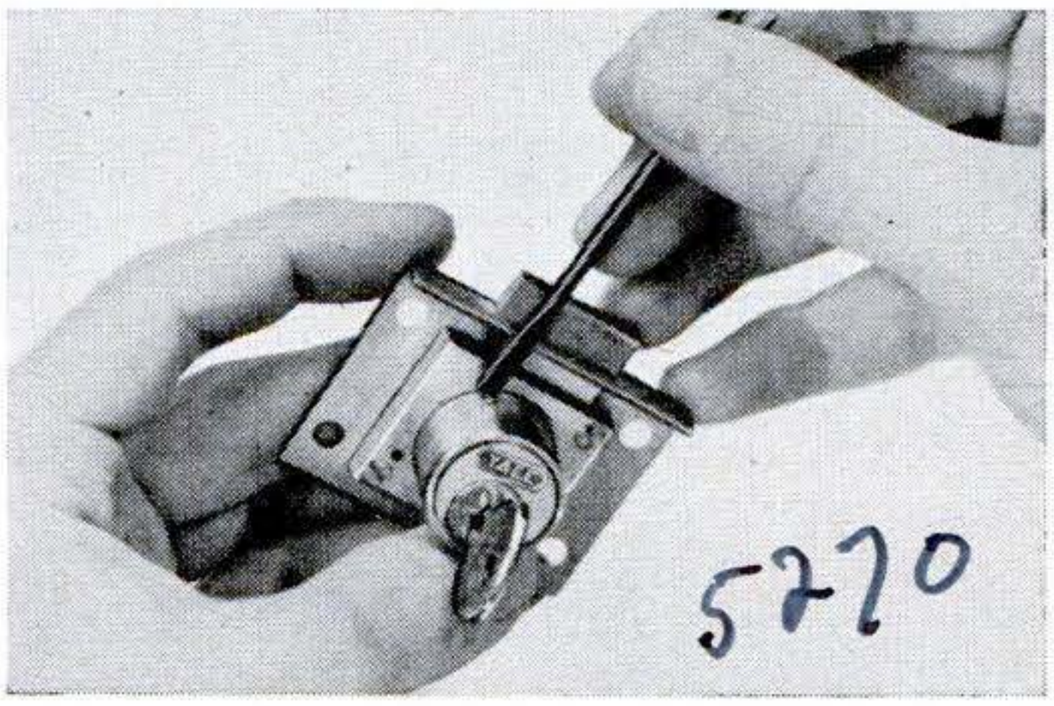
GIVEN any single dimension, here's a simple method by which modelmakers and draftsmen can quickly arrive at accurate scale sizes with little effort. For instance, if you're working from photos of a locomotive, all you'd need to know is one actual measurement, perhaps the stack height. You must of course avoid scaling lines of a picture that are foreshortened by perspective.

Or suppose you have the front elevation of a house that is drawn to scale, but on which only a few chief dimensions appear.

Begin by drawing a line A-A (Fig. 1). Then along this measure to scale the largest dimension you can find, 9′6″ in this instance. In ¼″ scale this measures 2⅜″ on line A-A. Now set your dividers to the 9′6″ space on the drawing (Fig. 2) and with this setting swing an arc from the measured point on A-A (Fig. 3). Next draw line A-B tangent to the arc. This is the base from which you determine other dimensions.

You can check the method by setting the dividers on another dimensioned part (Fig. 5). Then try them on line A-A until the arc just touches A-B (Fig. 6). Measure from the apex of the triangle to the point on line A-A and you'll find it's 15/16″ (Fig. 7). In ¼″ scale, this is 3′10″, the window height given in Fig. 1.—*Herbert Pfister, Bronx, N.Y.*





5270

New Lock Does Three Jobs

A ROTATING cylinder permits a new Yale & Towne lock to be adapted to any one of three purposes. If you wish, it can be installed as a drawer lock, with the bolt moving vertically. Should you need a cabinet or cupboard lock, a small catch may be released with a screwdriver or other simple tool and the cylinder rotated so that the bolt will move horizontally in either right or left-hand doors.

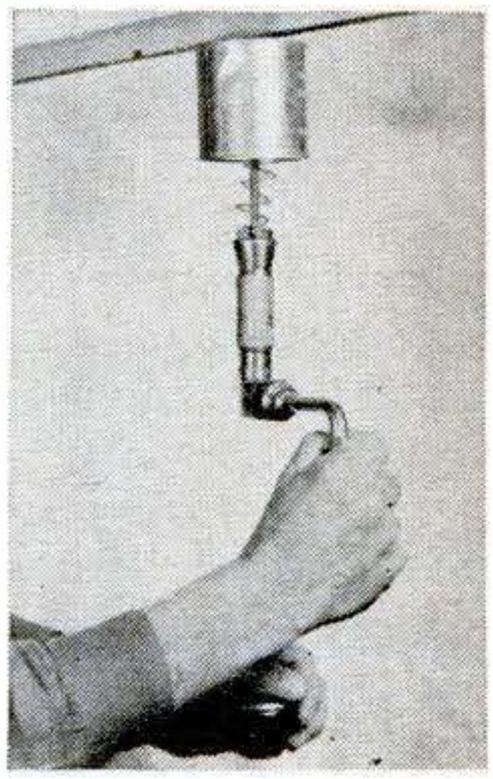
5375

Oil Soaking Cleans Wood Rasp

WOOD particles that have accumulated in a rasp may be cleaned out by soaking it for several hours in turpentine or lubricating oil. This will soften the dust, which may then be removed with a file card or a file brush.—*Paul H. Graham, Manchester, N. H.*

5417

Drill Chips Fall into Can



WHEN it's necessary to bore a hole overhead, a tin can placed over the bit will catch the falling debris and keep dust from your eyes. Punch a hole in the bottom of the can and slip it over the bit. A light spring will keep the can from tipping.—*Benj. Nielsen, Aurora, Neb.*

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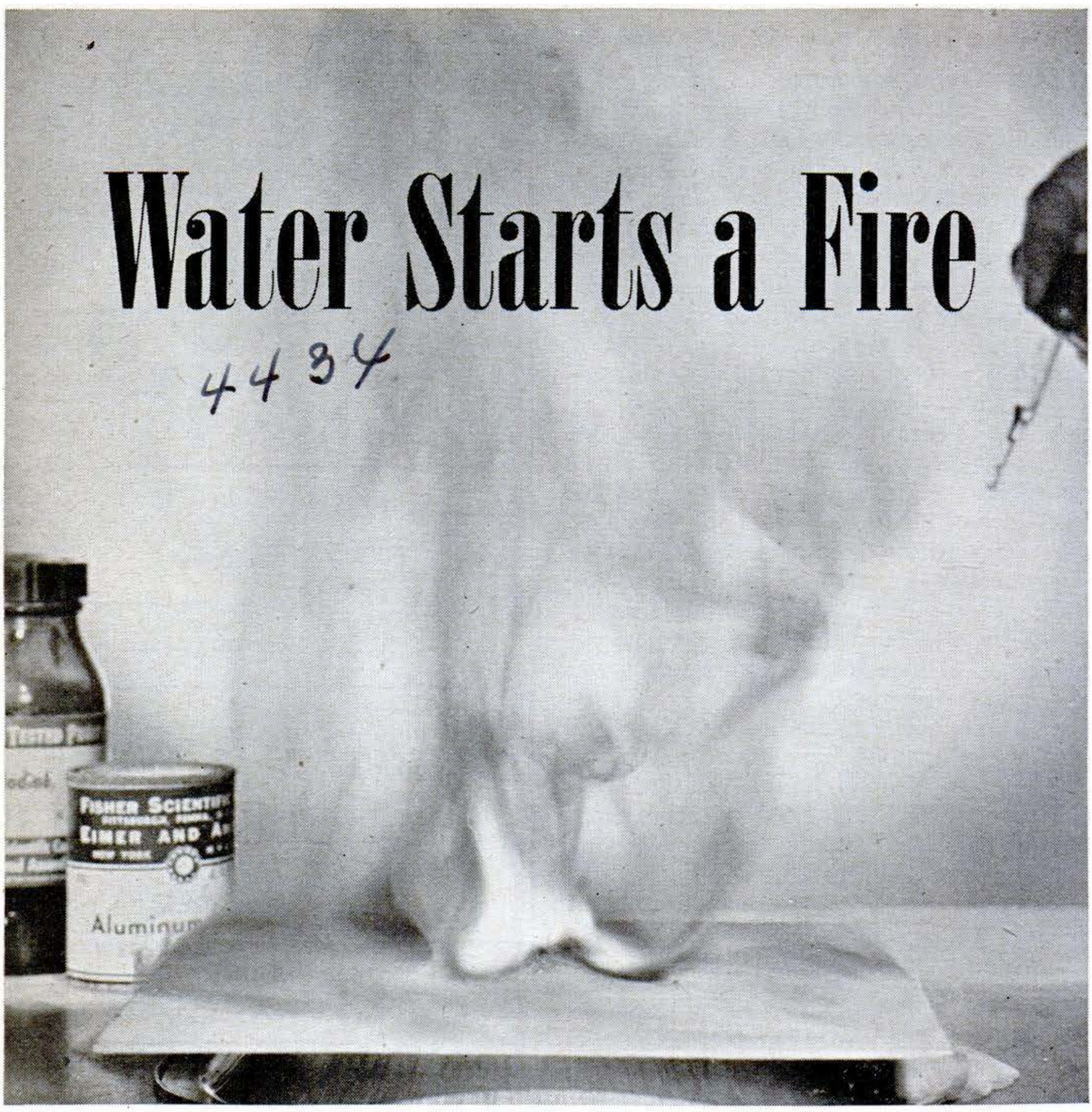
Water Starts a Fire

4434



One drop of water was the spark that set off this fire. The burning material is a mixture of iodine crystals and powdered aluminum. In the absence of water, it wouldn't have burned.

Ordinarily water helps to put out a fire, but in the field of chemistry the unexpected frequently happens.

By Kenneth M. Swezey

THERE are many stunts that can be done with water, but you'd hardly expect it to start a fire. Yet in chemistry you can find cases where a single drop serves as the spark to set off a spectacular bit of smoke and flame.

It does this by acting as a catalyst. This means that the water promotes a reaction between other substances without itself becoming chemically involved. When absolutely dry, certain materials react only feebly or not at all with each other. In the presence of a trace of moisture, they react violently.

Here's an example:

In a nonmetallic container, thoroughly mix 2 cc. volumes of powdered aluminum and iodine crystals. Don't get the crystals on your hands or metals, for this material is corrosive. Put the mixture in the center of an asbestos pad, and place this in turn on the bottom of an upturned pie tin.

Also spread out several thicknesses of newspapers under the pie tin. Otherwise, condensed iodine fumes may stain the table. The vapors that will be produced are very irritating, and the experiment must be performed in a well-ventilated spot.

When you're all set, make a little depres-

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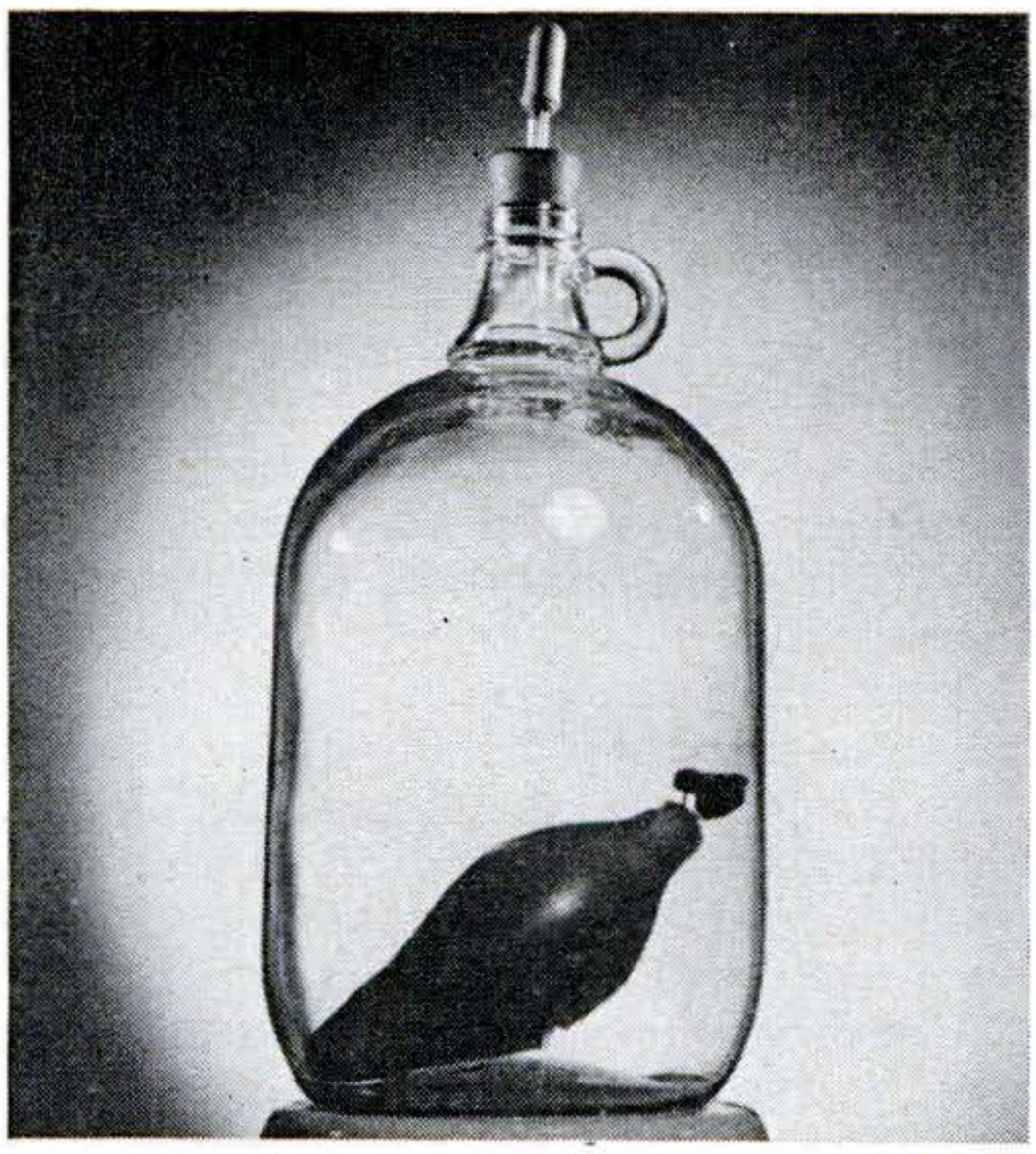
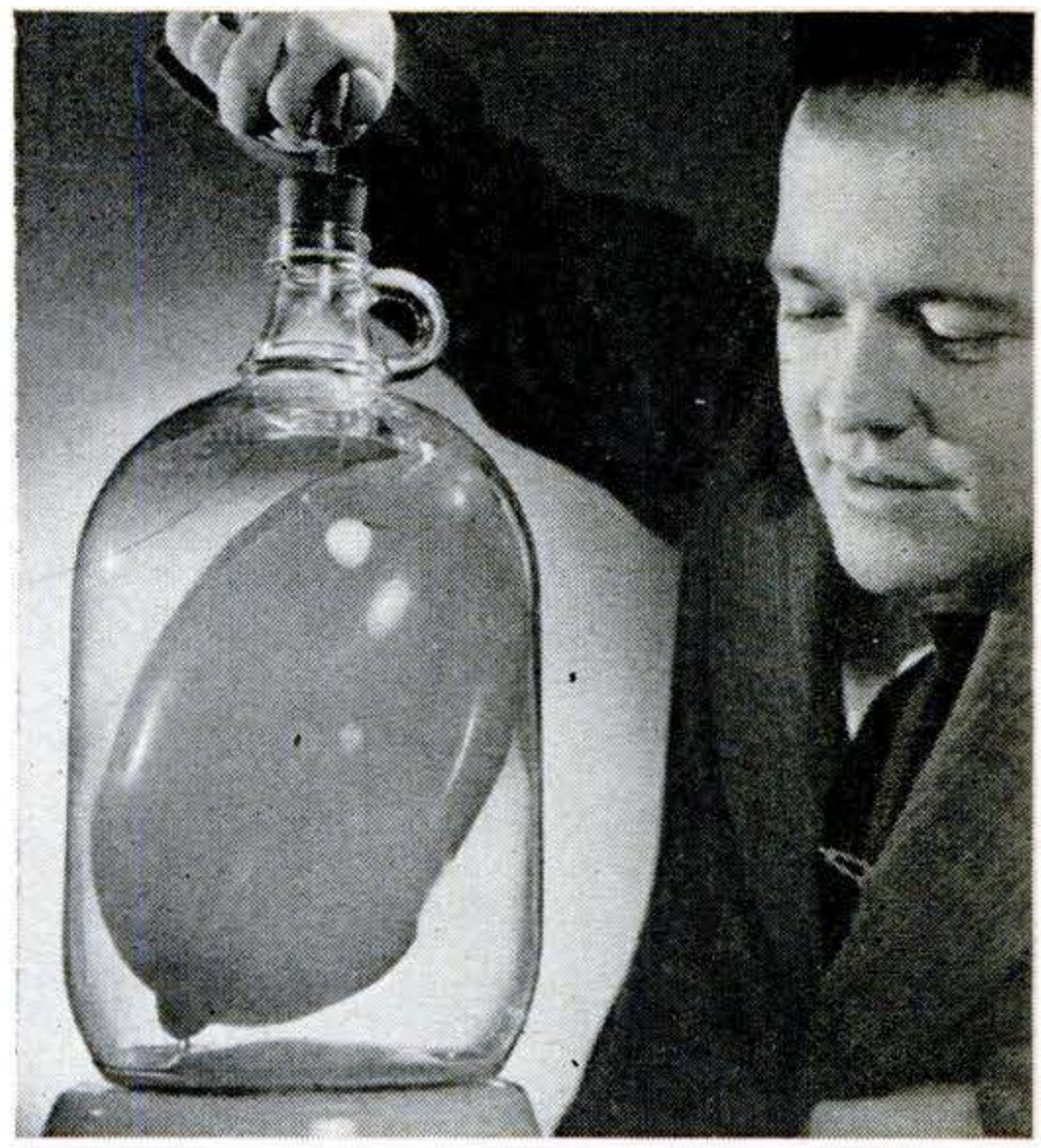
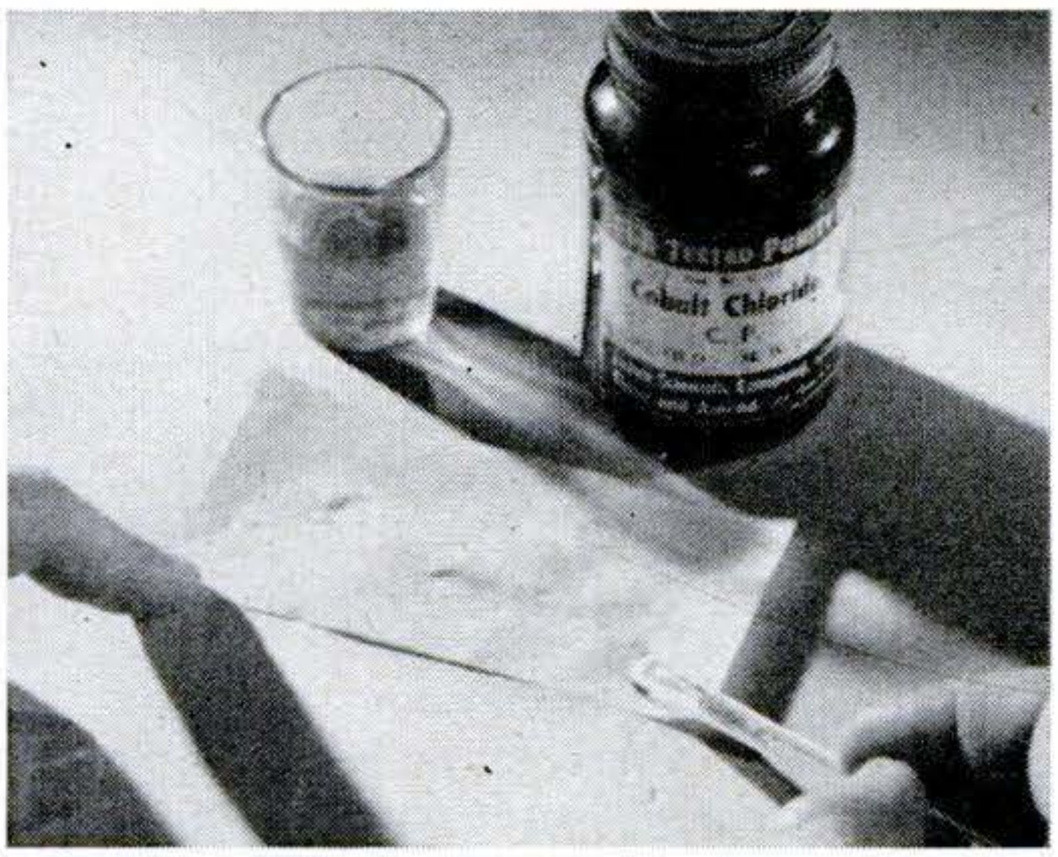
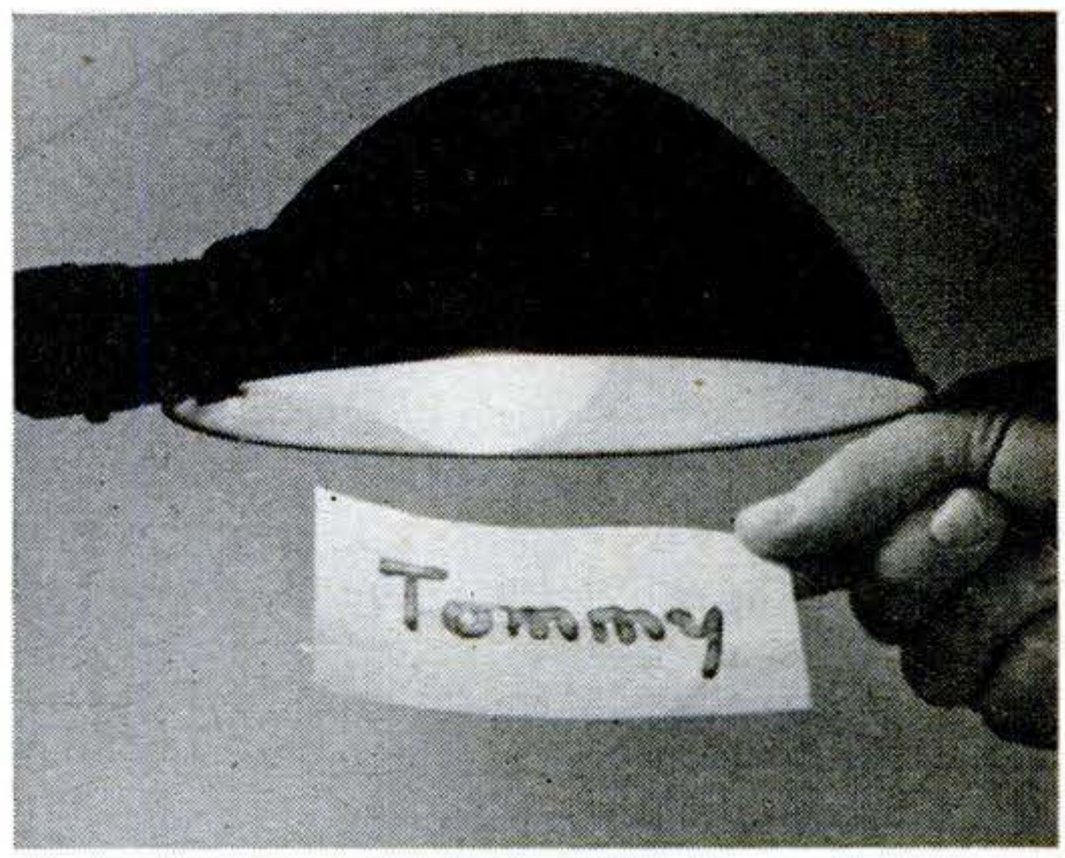




Water dissolves nearly 700 times its own bulk of ammonia gas. Here's a demonstration. A few drops of water absorb the ammonia in the jug. Greater pressure inside inflates the balloon.





Writing done with hydrated cobalt chloride is invisible while it's wet. But dry it and the writing stands out as a vivid blue. Water unites with many compounds to form hydrates.

sion in the mound of iodine and aluminum. Add just a drop of water and stand back.

Within a few seconds the mixture, catalyzed by water, will begin to react. At first little streams of violet-red iodine will creep down the mound. Then suddenly the mixture will burst into flame, accompanied by dense smoke in considerable volume.

The chemical symbol for water, H_2O, is almost as familiar to the ordinary person as the common name for the substance it represents. And rightly so, for ordinary water is a chemical compound of first importance.

To the chemist, perhaps the most useful property of water is its ability as a solvent. You're familiar with the way it dissolves solids and other liquids.

But did you know that, at room temperature, it can dissolve nearly its own volume of carbon dioxide (soda-water gas), 50 times its own volume of sulphur dioxide, 400 times of hydrogen chloride, and nearly 700 times its own bulk of ammonia?

You can easily demonstrate the astonishing ability of water in dissolving ammonia.

Put a toy balloon into a 1-gal. glass jug, inflate it slightly with a glass or rubber tube, and seal it with a rubber band. Then turn the jug upside down and fill it with ammonia gas.

To generate the ammonia, place a few grams of sodium hydroxide in the bottom of a small flask, fit the flask with a two-hole stopper, and pass the stem of a dropping

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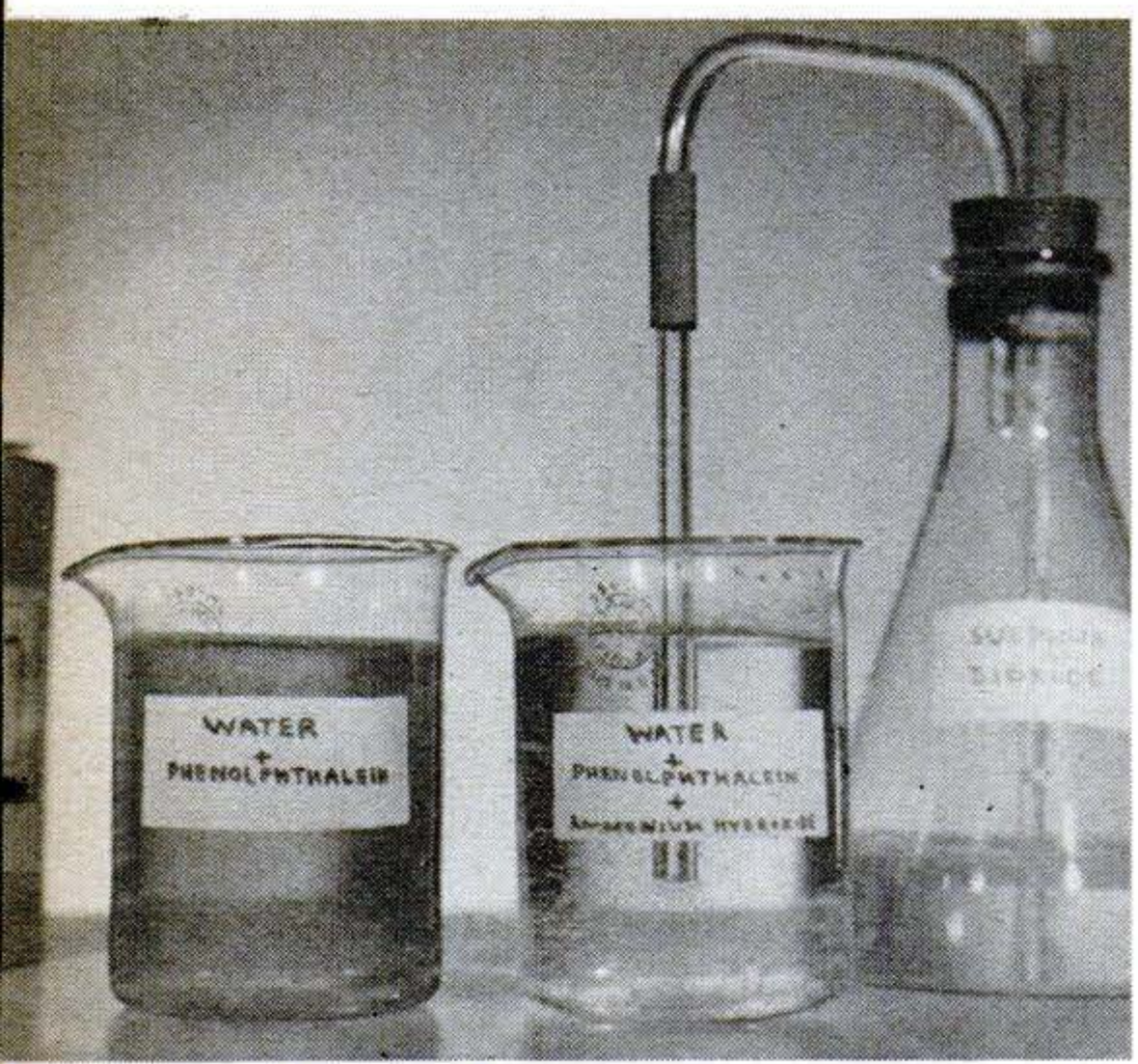

Water forms acids when it reacts with oxides of nonmetals, bases when it reacts with the oxides of metals. You can use the setup above as explained in the text to demonstrate this.

funnel through one hole. Put a delivery tube in the other hole, leading it to the mouth of the upside-down jug. Then let concentrated ammonium hydroxide fall drop by drop on the sodium hydroxide.

When the jug is full of ammonia (evidenced by a strong smell of the gas coming from the neck) turn it upright. Close the jug quickly with a stopper through which has been pushed a medicine dropper full of water.

Now squeeze the bulb of the dropper. Practically at once a good part of the ammonia in the jug will dissolve in the few drops of water. This will make a sharp reduction in the gas pressure in the jug. Because the pressure inside the balloon is now much greater than the pressure outside, the balloon will blow up to many times its original size.

Water is an extremely stable compound, but it often reacts chemically with other substances that it touches. An amateur chemist should learn to distinguish between cases where water enters into a true chemical combination and those where it is merely a mechanical accessory.

In one of the most familiar instances of chemical combination, water unites with certain compounds to form still more complex compounds called hydrates. Chemically speaking, a hydrate is identical with the dry substance except that each molecule contains a definite number of water molecules.

Physically, however, the substances may appear different. For instance, hydrated copper sulphate crystals are blue. Anhydrous, or dry, copper sulphate on the other hand is almost white. Hydrated cobalt chloride is pink, but the anhydrous form is blue.

The color-changing characteristic of cobalt chloride is often put to use. You may perhaps have come across such uses in cloth flowers or trick dresses that become alternately blue and pink with changes in air moisture.

Cloth may be easily prepared for such purposes simply by dipping it into a rather strong solution of cobalt chloride. If the cloth is then dried over heat, it will be a brilliant blue. Merely breathe on it, however, and it will magically turn pink.

One form of invisible ink may be made by using a more dilute solution of cobalt chloride. Unless thoroughly dried, writing done with this solution will remain invisible. Heat it, however, and it may be easily read.

Humidity indicators that change color also make use of cobalt chloride.

In some cases, water reacts to form completely new substances. With the oxides of metals, for instance, it forms bases; with the oxides of nonmetals, it forms acids.

To show this double nature, fill two beakers with water and add a drop of phenolphthalein test solution to each as an indicator. This indicator turns pink when the solution is basic, but remains water-white when it is acid or neutral.

Add a drop of ammonium hydroxide to one of the beakers to make the solution slightly basic and turn it pink. To the other add a few grains of calcium oxide (quicklime). This solution will immediately become colored, indicating that the neutral calcium oxide has changed to calcium hydroxide (slaked lime), a base.

Now make some sulphur dioxide gas with a generator similar to that used previously for the ammonia. Put a solution of sodium bisulphite in the flask and a little concentrated sulphuric acid in the dropping funnel.

Let the sulphur dioxide gas bubble through the slightly basic water in the first beaker used in the present experiment. After a few minutes, the pink will disappear, proving that the ammonium hydroxide has been neutralized by an acid produced by the reaction of water with sulphur dioxide. This is sulphurous acid, an unstable compound that's responsible for the bleaching power of sulphur dioxide. END

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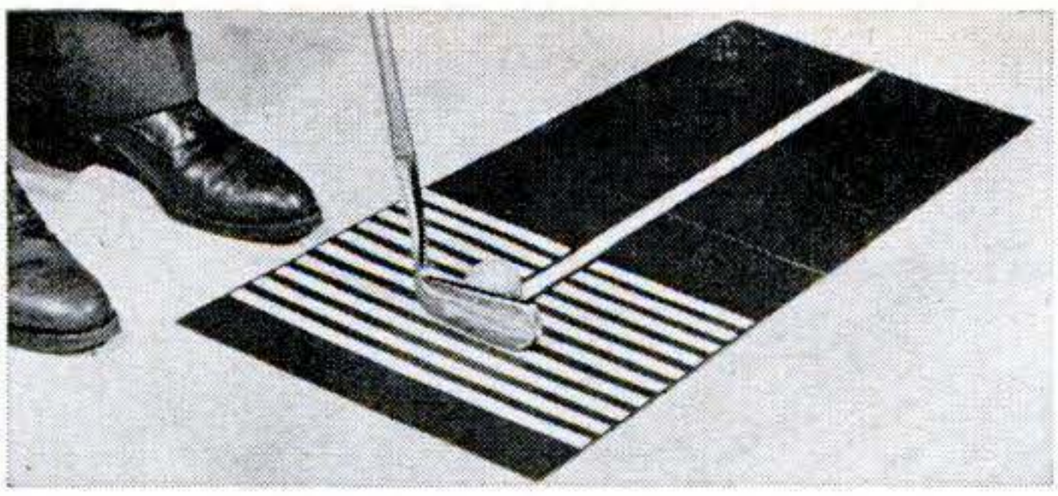

Visual Guide Aligns Putts

As GOLFERS know, a putter must be lined up squarely if you expect to sink a putt. But alignment is not always easy. Here's a visual aid for practice putting, made by Crittenden Associates, Chicago. At right angles to the line of travel are contrasting white and black lines. When the putter head moves back and forth over this, it's claimed that any misalignment is quickly noticed.

5349

Grill Packs Up for Carrying

PICNICS anywhere are a cinch with a new portable charcoal grill and broiler introduced by Torngren Stainless Steel Products, Inc., Somerville, Mass.

When packed, the 7-lb. grill tucks away in a space only 7″ by 13″ by 13″. Inside the case there's ample room for a generous supply of charcoal. A catch prevents accidental opening of the lid.

At the picnic grounds, it can be set up in a few seconds. Unpack the parts, invert the body of the case, and insert the three legs in the slots that are provided. Fit on the cone-shaped burner, install the grate, and you're ready to fire up.

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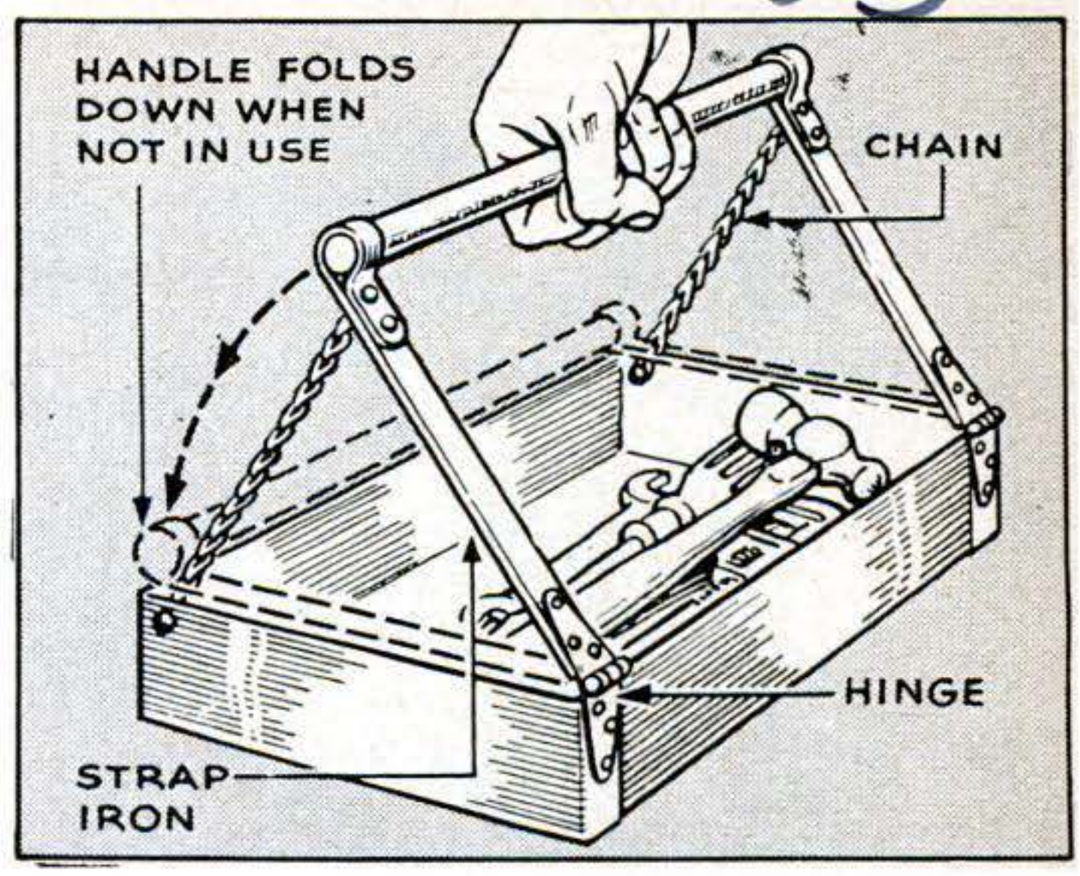
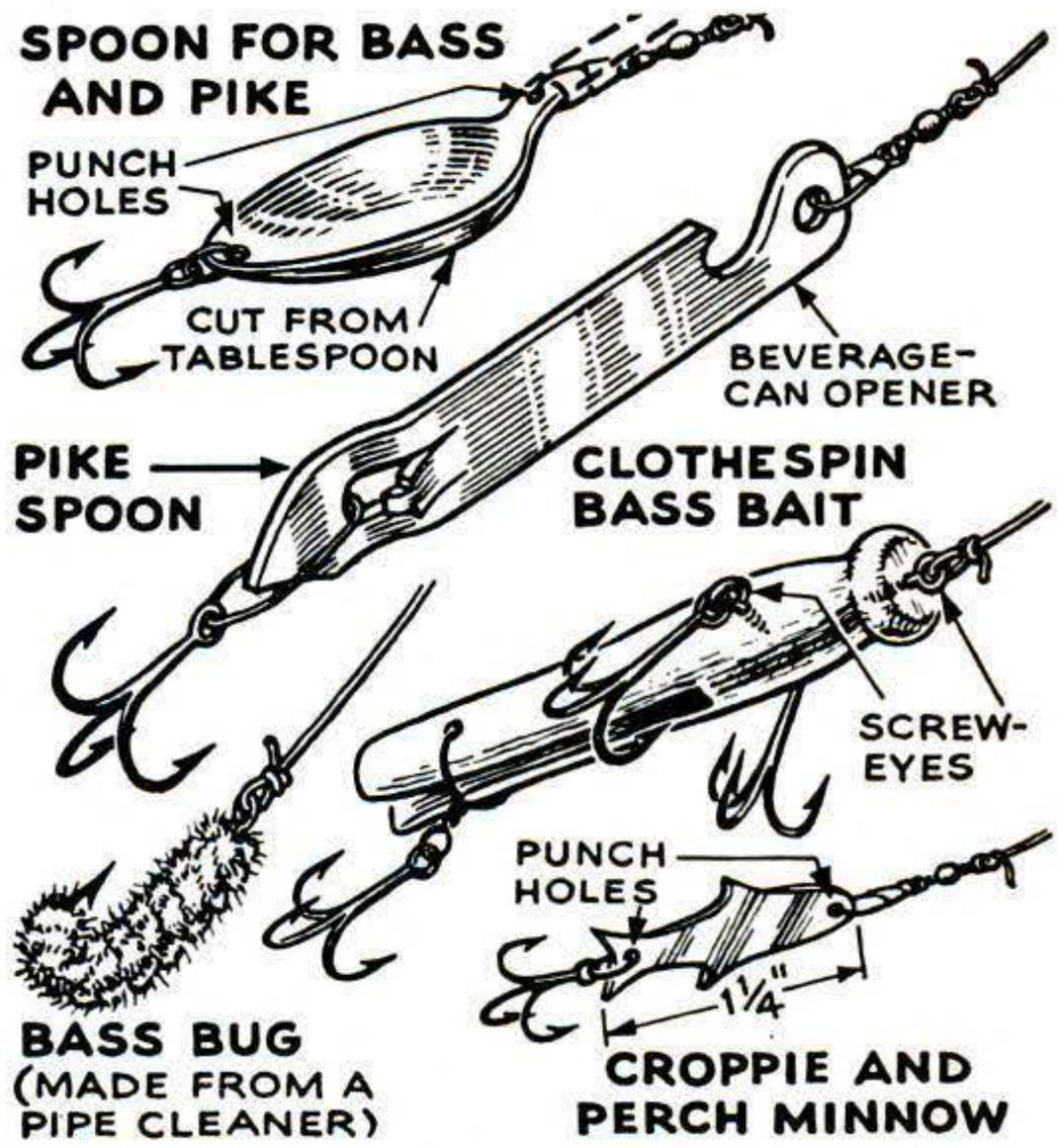


Tool Tray Has Hinged Handle

THERE'S no handle in the way when you want to remove tools from this tray. Set down the tray after carrying it to the working area, and the hinges allow the handle to drop against one side. Two short lengths of furnace chain limit the travel of the handle.—*Asher Wolfe, Bloomsburg, Pa.*



Odds and Ends Lure Fish

IF YOU'D like to spend an evening or two experimenting with homemade fishing lures, you may be surprised at how you can both save cash and catch fish. The ones above may not be as fancy as those you can buy, but each has proved its worth on the line.

As you'll note from the drawing, all the lures call only for common materials. At least two can be made in a few minutes for emergency use. Cut the minnow from tin-can stock.—*R. A. Jenkins, Los Angeles.*

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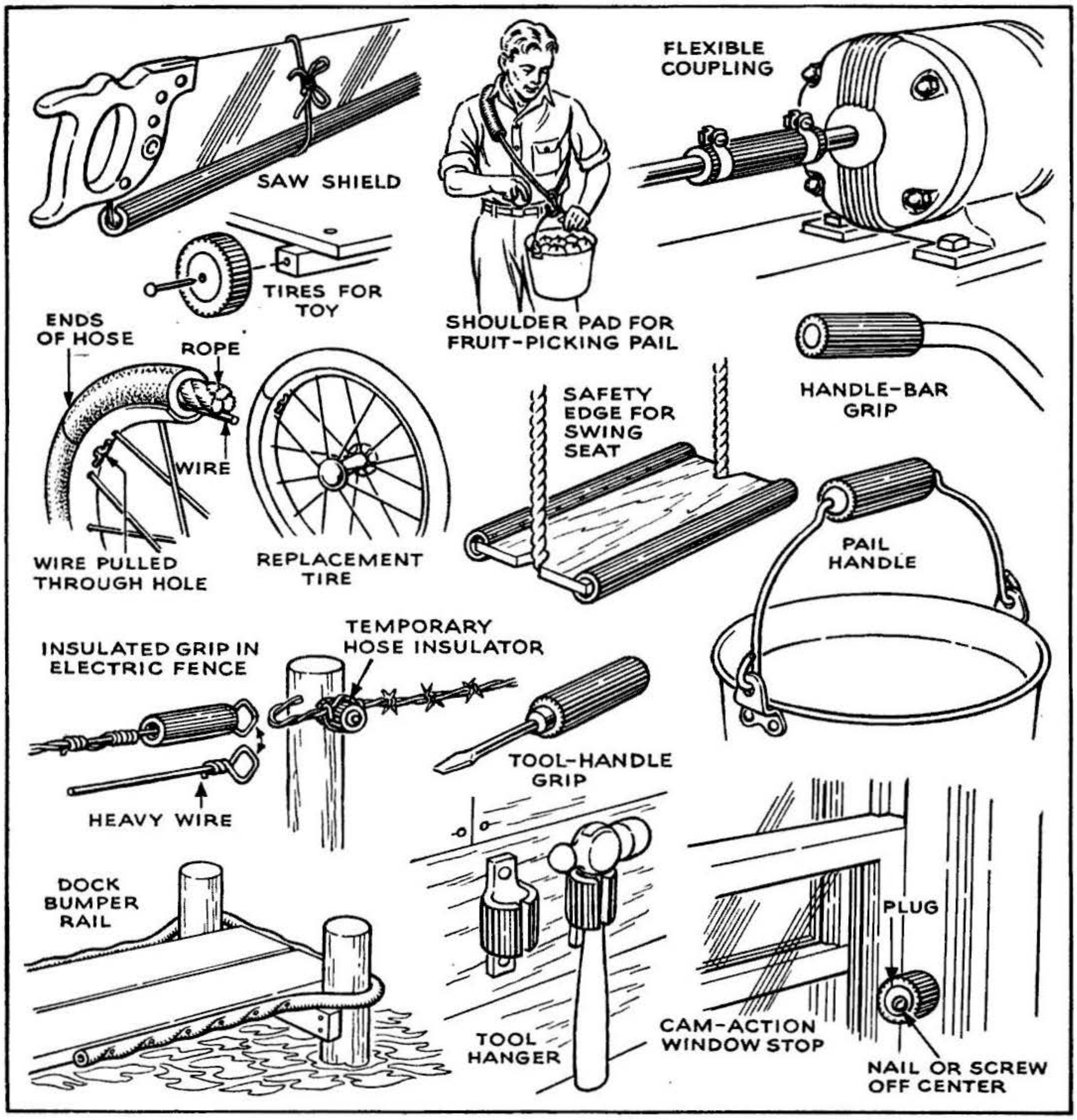


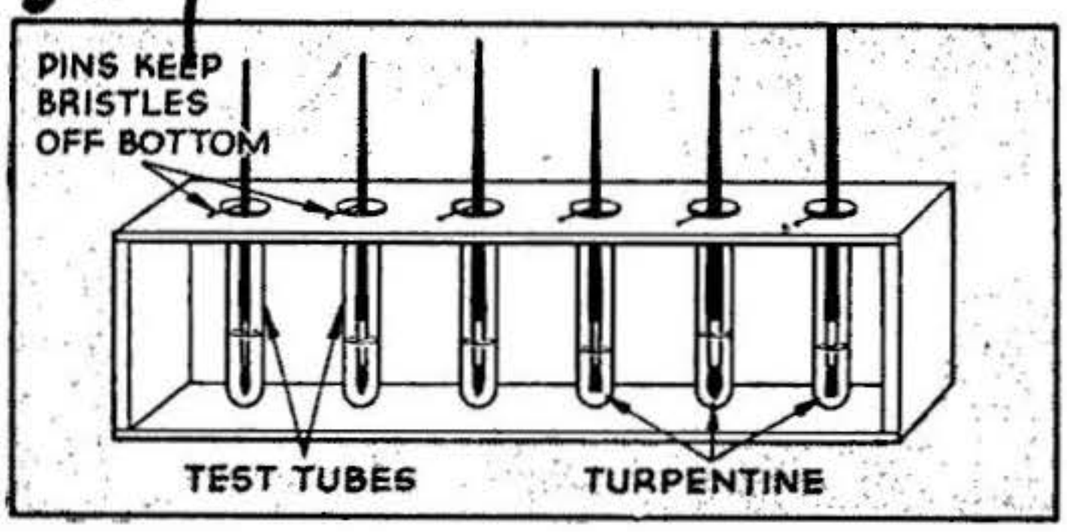
Fourteen Uses for Old Garden Hose

If you've bought some sleek new garden hose, don't be too quick to throw out the leaky old hose. Suggested above are some general applications, and you'll find plenty of others. If you have to slit a length, as in getting it on a pail handle, a linoleum knife does the job nicely. Cement the hose on hardwood dowels in making window-lock cams or miniature toy wheels.—*Ralph S. Wilkes, Keuka Park, N. Y.*

5367

Cheese Box Makes Brush Rack

Test tubes set in holes bored in one side of a cheese box are ready holders for small brushes. Use pins to keep the bristles off the bottom, and add a small amount of turpentine to each tube to keep the bristles soft. The box may be screwed to a wall or cabinet.—*Victor H. Lamoy, Upper Jay, N. Y.*



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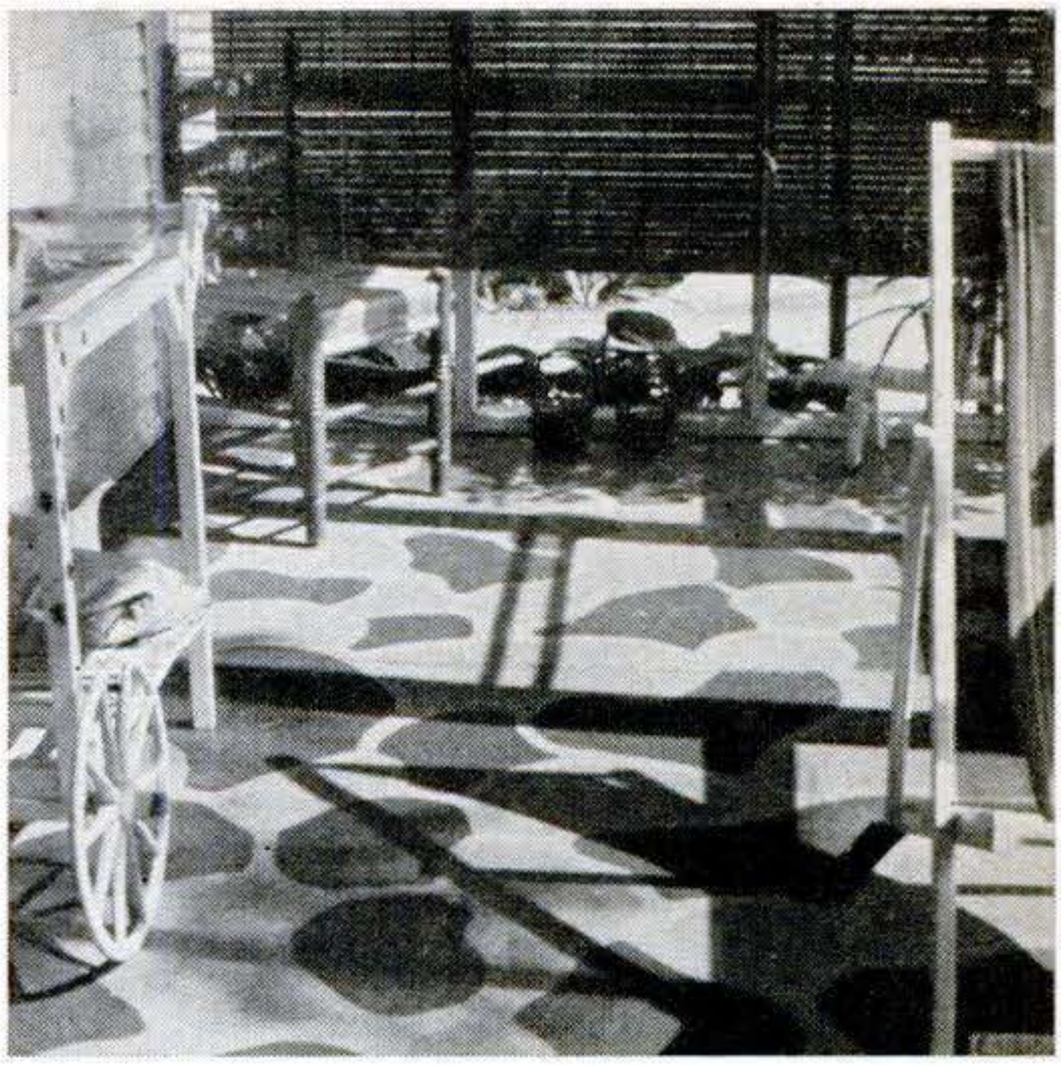
Painted "Flagstones" Brighten Porch or Patio

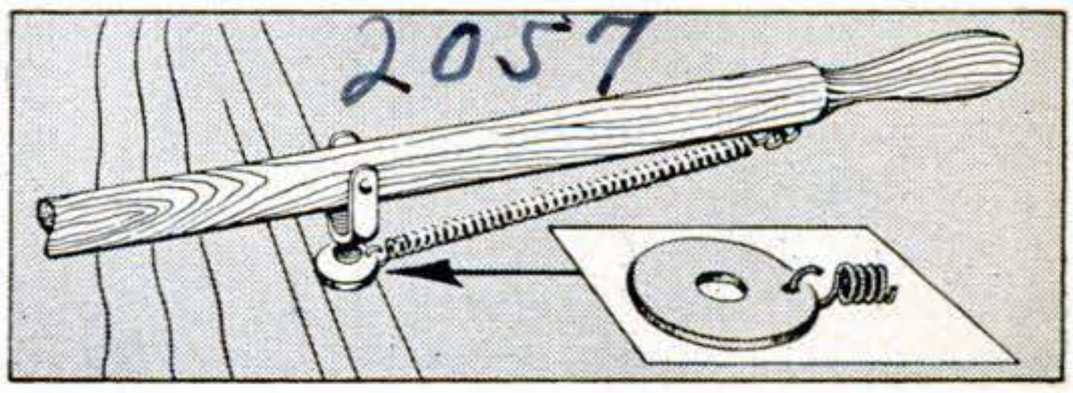


WITH a few cans of enamel, any cement floor can be painted to simulate flagstones. Use paint suitable for cement.

Clean grease and dirt from the floor with a solution of one part muriatic acid and three parts water. Wear rubber gloves and apply it with a mop or broom. After the acid has stopped bubbling, in 20 or 30 minutes, wash the floor with a hose.

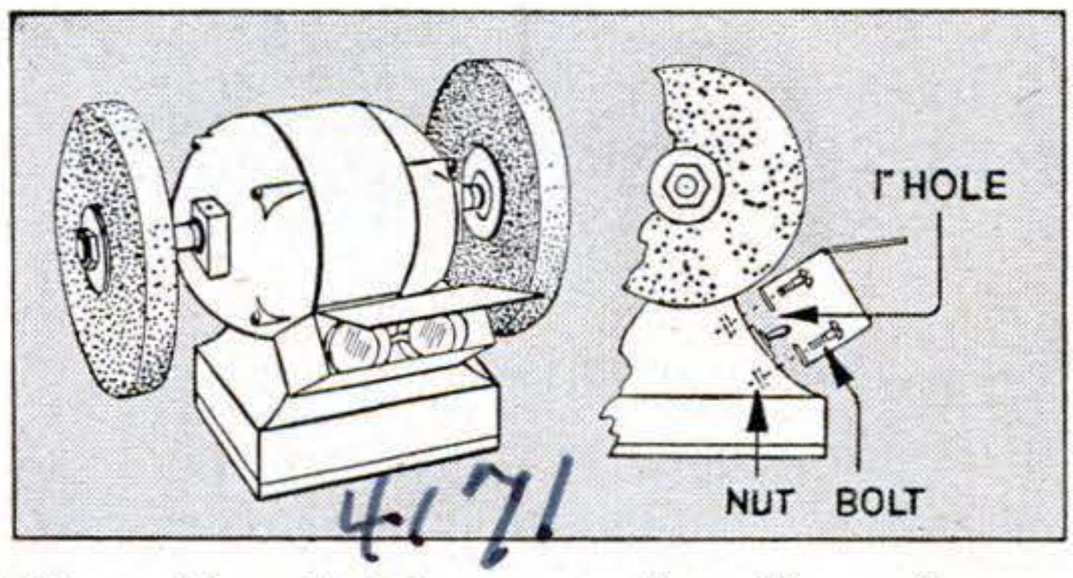
Select two colors of paint that somewhat resemble natural stone. I used brick red and sandstone. Paint the "stones" in irregular sizes and shapes, leaving a 1½" band between each. After two coats have been applied to the "stones," paint the bands a French gray. Then cover the entire floor with two coats of high-grade spar varnish. —*Jack W. Jennings, Kansas City, Mo.*

Springs Lighten the Job of Handling Heavy Oars



BOATS with heavy oars can be rowed more easily if you attach a screen-door spring to each of the oars as illustrated. The springs support part of the weight of the blade on the return stroke.

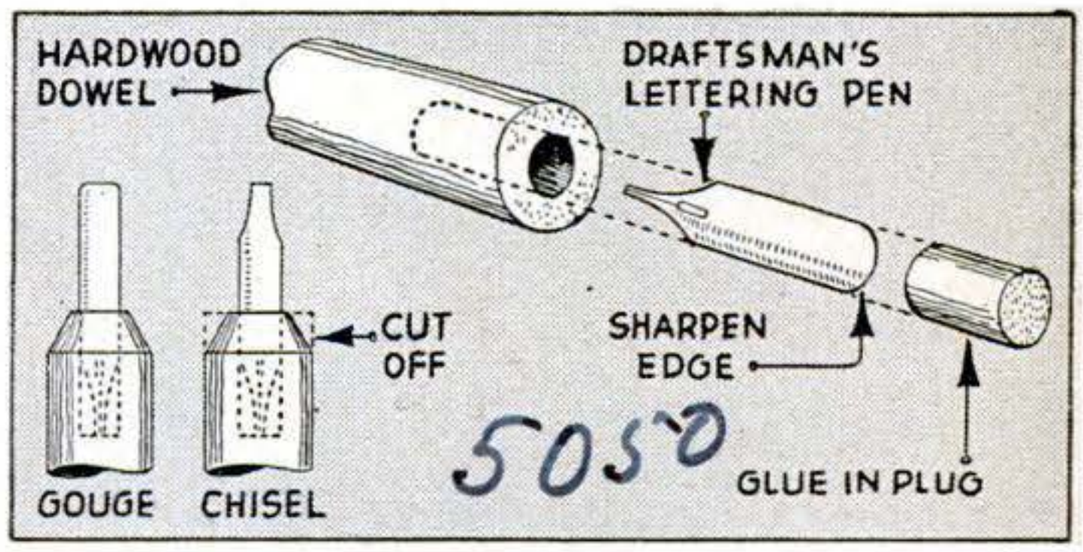
Insert a screw eye under each oar adjoining the grip. Attach one end of the spring to this. The other end may be anchored in one of several ways. Perhaps the simplest is another screw eye placed just under the oarlock. A piece of heavy wire also might be twisted in the lock. The most shipshape, however, is a hole drilled near the edge of a large washer around the oarlock.—*Ralph S. Wilkes, Elbridge, N. Y.*



You Can't Forget the Goggles

IF YOU sometimes forget to wear protective goggles while using a grinding wheel, here's a hint that will force you to remember them.

Over the switch mount a 2" by 2" by 6" wood box. Anchor it by drilling holes in the grinder base and inserting two small bolts. Place a hinged lid on the box and keep your goggles there. You then can't reach the switch unless you first remove the goggles.—*W. H. Grant, Pleasant Valley, Iowa.*



Carving Tool Made from Pen

CRAFTSMEN who carve miniature models frequently have difficulty locating steel gouges and chisels sufficiently delicate for the work. I've found that excellent tools can be made from lettering pens.

Mount the pen in a hollow hardwood dowel with the point inward, anchoring it with a plug glued in place. Taper the tool end of the holder. Sharpen the edge of the point and grind it to the desired shape.—*K. T. Fowler, Evanston, Ill.*

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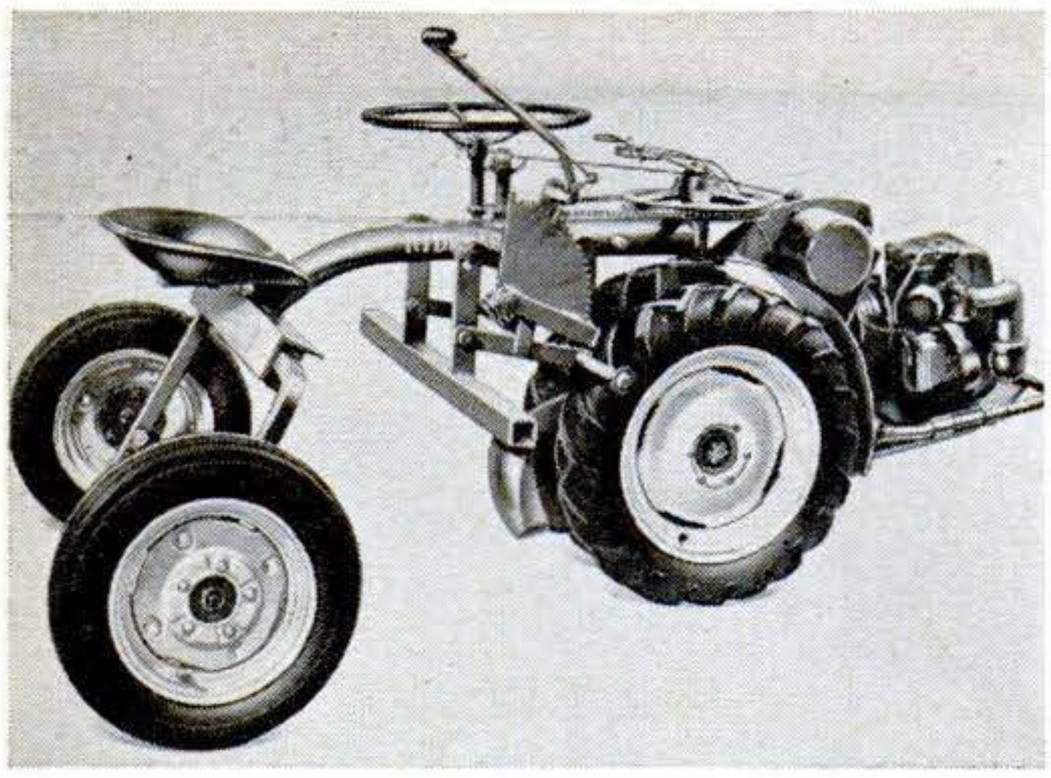
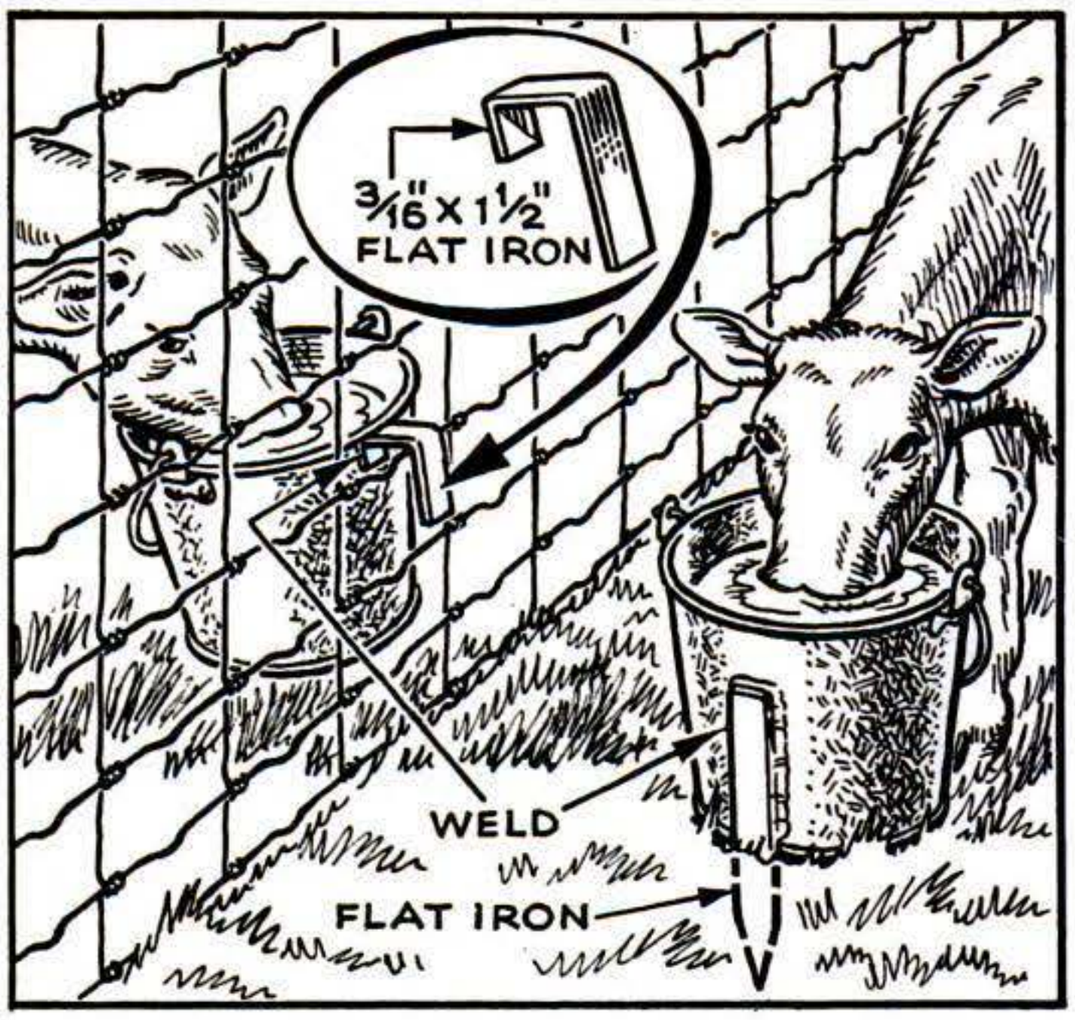


Tractor Built Like Tricycle

So CLOSELY spaced are the front wheels that this lightweight tractor has tricycle-like maneuverability, turning easily in its own length. The front-mounted, air-cooled, 5-hp. gas engine provides dead weight for extra traction, while one or two 50-lb. weights may be fitted to each rear wheel. Spacing of the rear wheels is adjustable from 38″ to 72″, and one rear wheel may be set to roll on a lower plane than the other. Tool-bar control is simplified by heavy coil springs. More springs for heavier tools may be added to the 725-lb. tractor. The Ridemaster Ⓣ is manufactured by the Bolens Products Division of the Food Machinery Corp., of Port Washington, Wis.



Two Ways to Stop Pail Upsets

CALVES, colts, and other young stock often upset their pails when feeding or drinking. Two methods of permitting the stock to be self-fed, yet guarding against upsets, are shown above. At the left, a piece of iron—bent as shown—is welded or soldered to the bucket, allowing it to be hooked on a fence or gate. At right, a flat piece of iron with one end sharpened is joined to a pail. The spike is forced into the ground at feeding time, holding the pail upright.—*Victor H. Lamoy, Upper Jay, N. Y.*

Hook Near Faucet Is Handy for Washers

6037

A CUP hook screwed into the wall near an outdoor faucet is convenient for hanging spare garden-hose washers. Those extra washers also will remind you to check the washer as you unscrew the hose and, if it is loose, to remove it.—*Robert Hoppough, Waukegan, Ill.*

6091

Two-Ton Hoist Built by Farmer

EARL DEARDORFF, Hale, Mo., farmer, took a lot of kidding from neighbors when he built the gallows-like machine pictured at left, but the hoist quickly proved its usefulness. One of its first jobs was pulling a neighbor's prize bull from a cistern where it had fallen. Built of I-beams and channel iron, the 13′ hoist is one of the farmer's most valued pieces of equipment. With it he lifts hay racks onto wagons, raises tractors for repairs, yanks out posts imbedded in concrete, and hauls damaged farm equipment to his repair shop. The hoist, mounted on Ford V-8 wheels, is pulled by truck or tractor.—*Harold Severson, Kenyon, Minn.*

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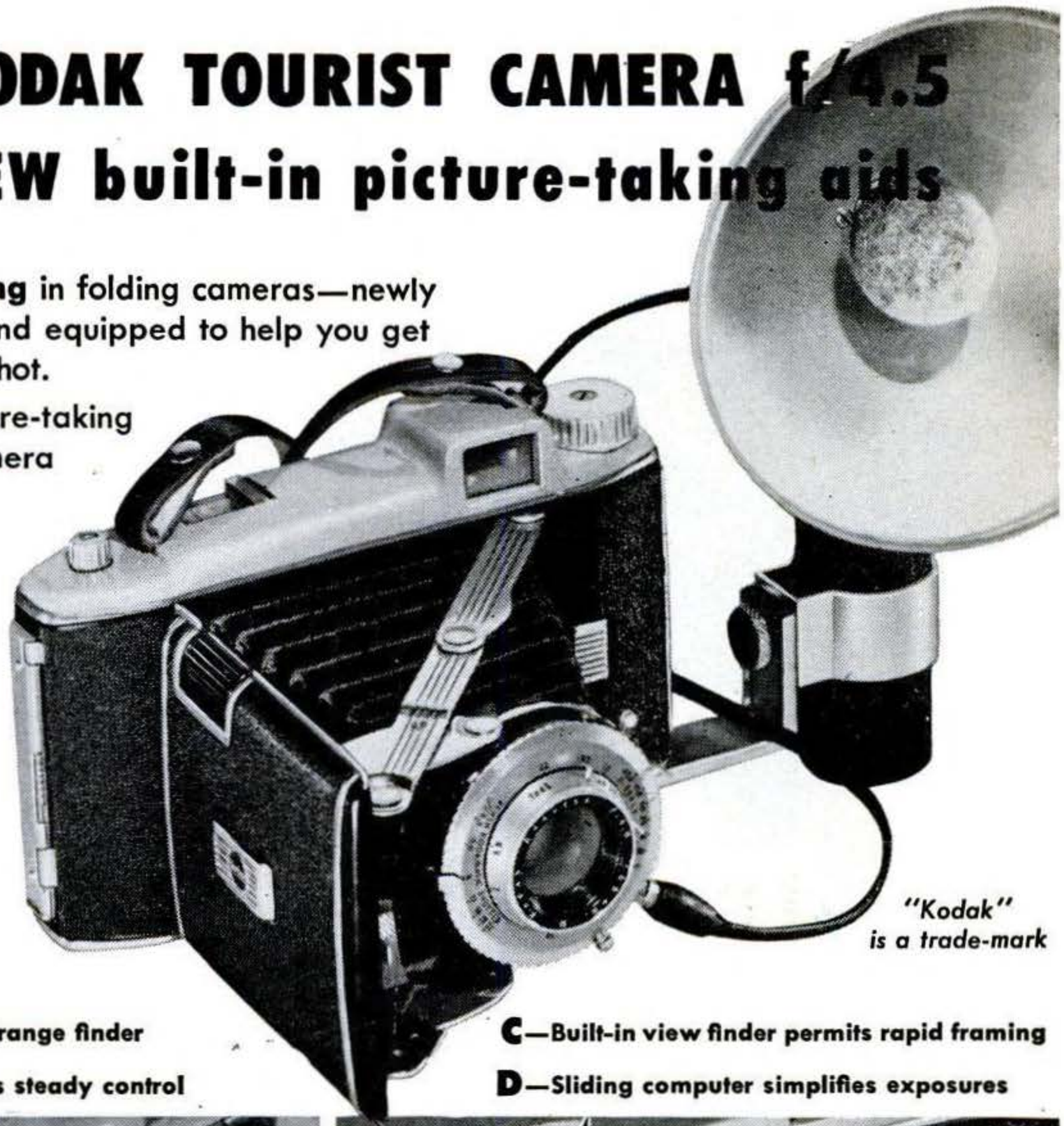


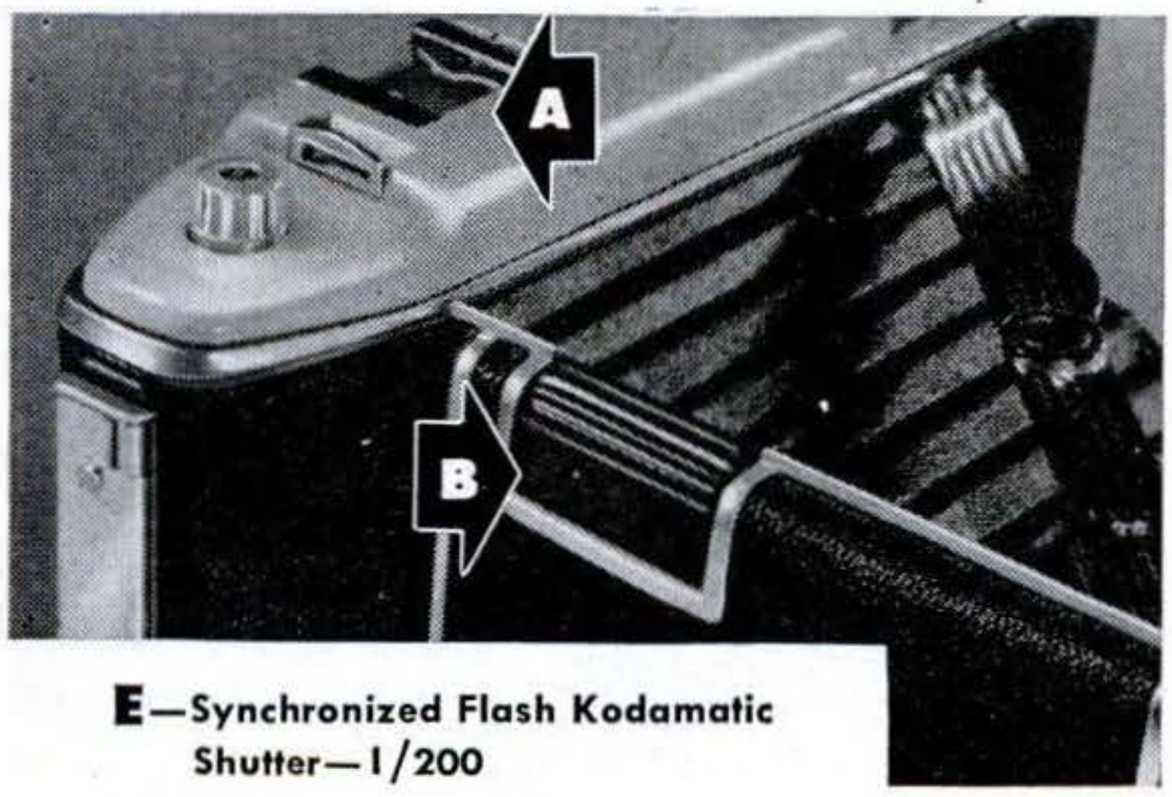
"Kodak" is a trade-mark

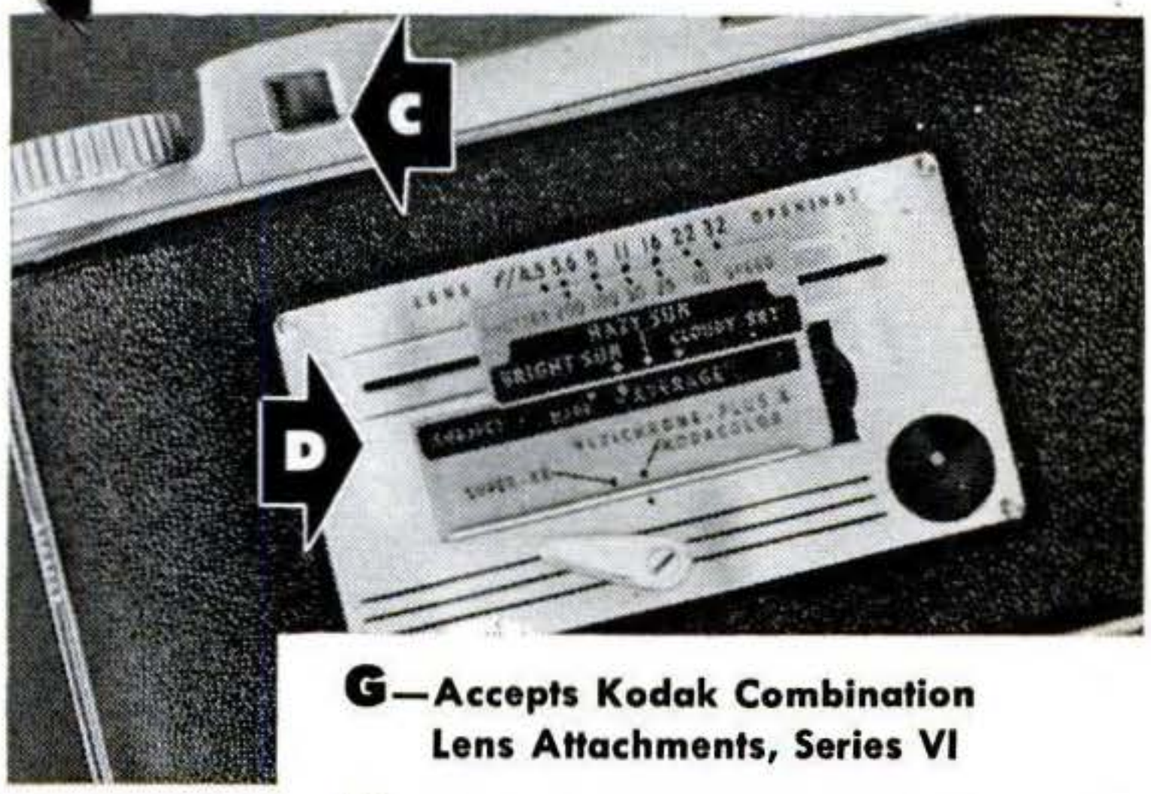
A—Bracket takes accessory range finder

B—Bed shutter release gives steady control

C—Built-in view finder permits rapid framing

D—Sliding computer simplifies exposures



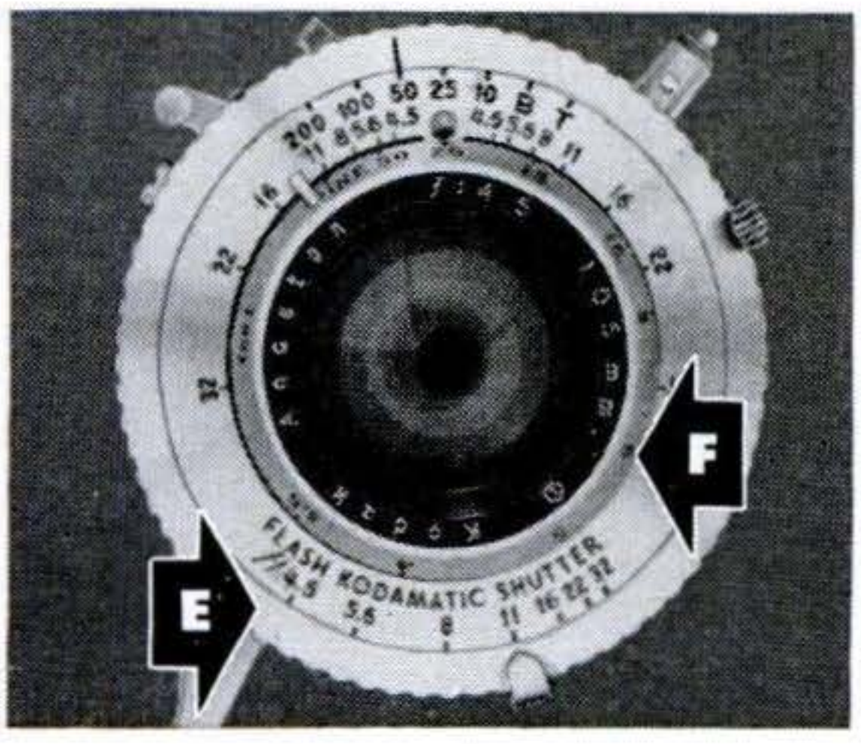


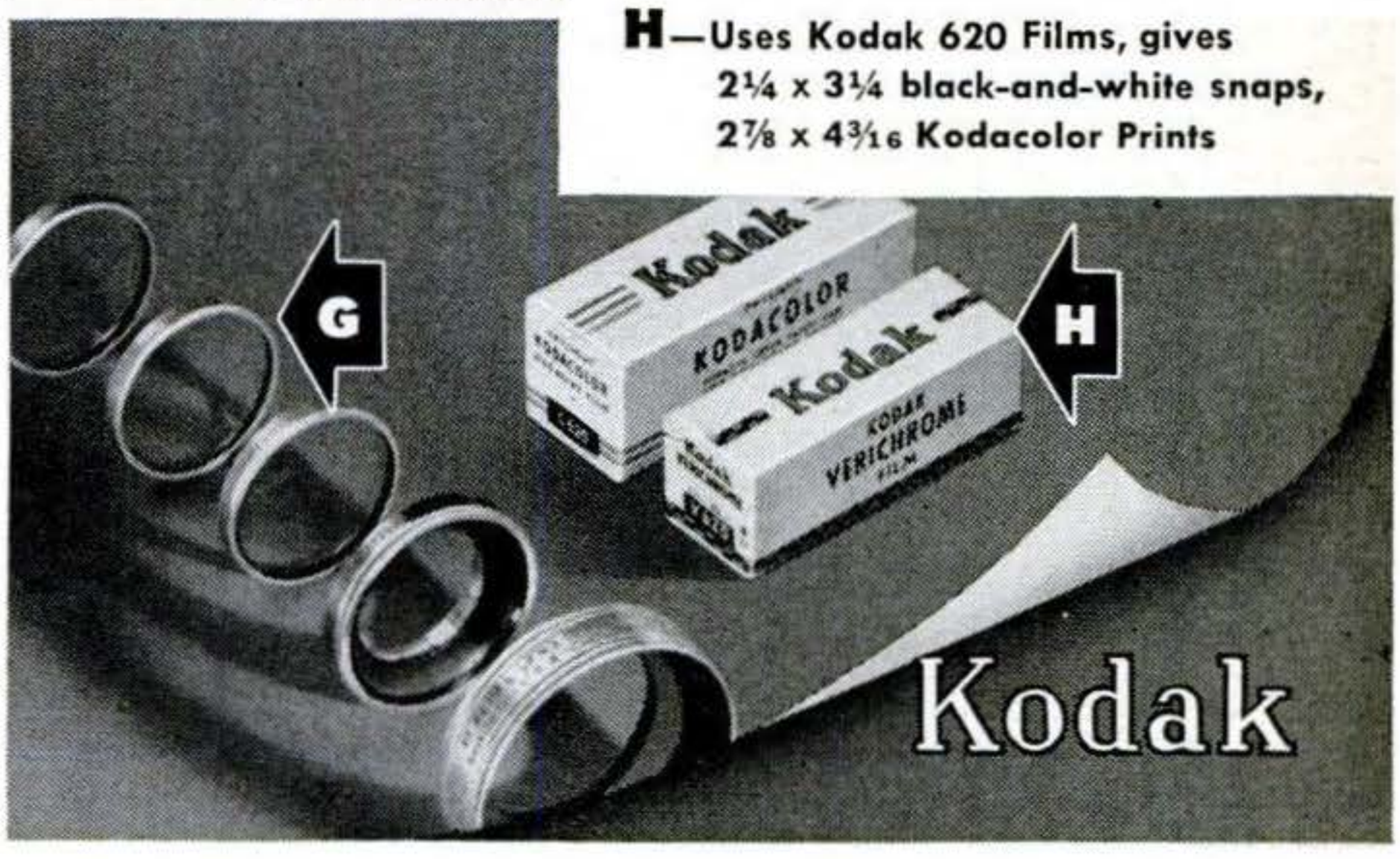
E—Synchronized Flash Kodamatic Shutter—1/200

F—Depth-of-field scale etched on lens mount

G—Accepts Kodak Combination Lens Attachments, Series VI

H—Uses Kodak 620 Films, gives 2¼ x 3¼ black-and-white snaps, 2⅞ x 4³⁄₁₆ Kodacolor Prints





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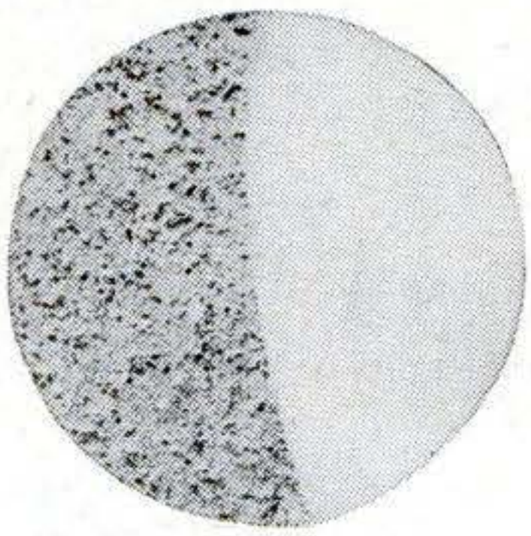

A small section of the surface of an average car magnified 20 times. The left side is shown still covered with Traffic Film. The right side has been cleaned with Du Pont NO. 7 POLISH

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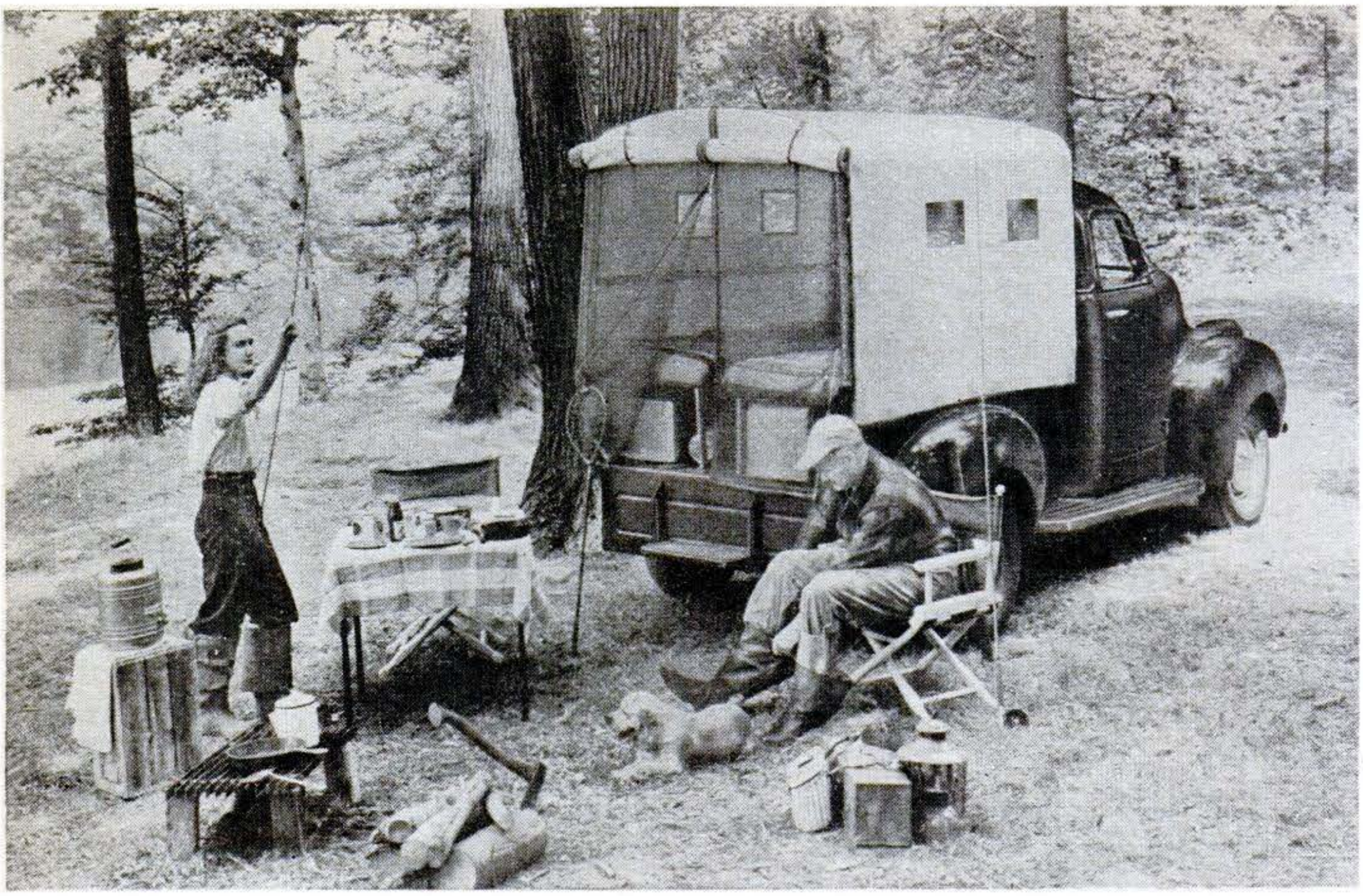
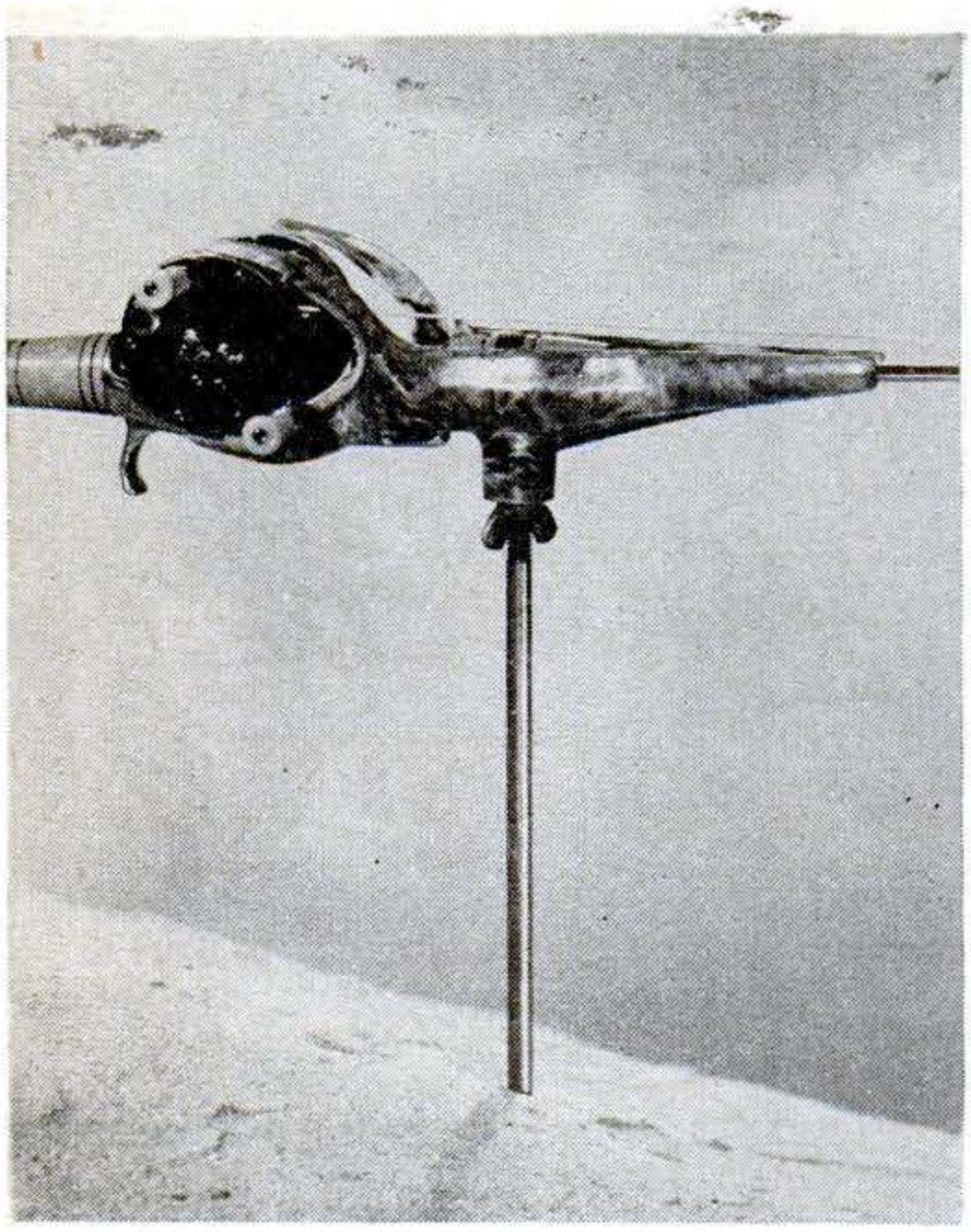


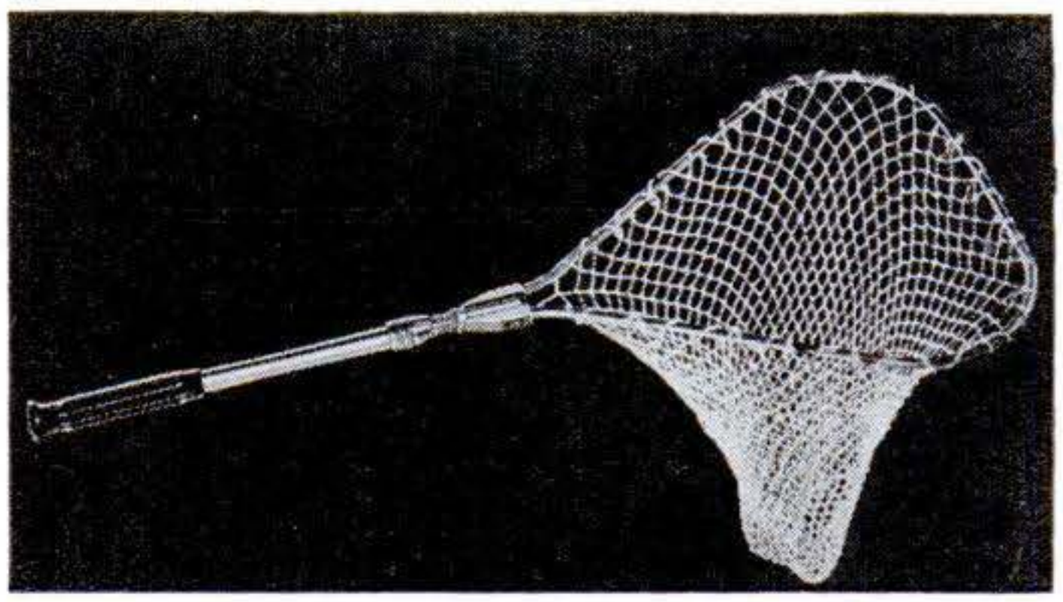
Tent Rides on Truck

HERE'S a way to turn a pickup truck into a mobile bunkhouse for camping trips. The Sportsman's Top Ⓣ, shown installed, consists of waterproof-canvas walls and roof over an aluminum frame. After assembly, it can be attached in 15 minutes by fastening only four bolts. The rear end has both a roll-up wall and a plastic screen to keep out insects. Box springs on legs make removable bunks over storage chests.



'Hand' Holds Fishing Rod

A NEW rod-and-reel anchor, shown above, lets a fisherman doze while waiting for a bite. The holder is molded of tough, flexible plastic over a brass bushing that screws onto a metal mast 23 inches long. While the rod lies in a trough, springlike prongs grip the reel. The device is made by Allegheny Mold & Die Co., of Oakmont, Pa.



New Net Weighs 12 Oz.

THANKS mainly to its hollow aluminum handle, this sturdy new net for game fishing weighs just 12 ounces. Only 16¾ in. long when folded, it opens to 29¾ in. and can be extended to 39¼ in. Made by Stream-eze, Inc., of South Bend, Ind., it has a bail of Dowmetal Ⓣ, brass fittings, rubber handhold, and net of cotton or nylon.

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NOW THOUSANDS WHO NEVER RODE BEFORE CAN ENJOY MOTORCYCLING

NEW Indian LIGHTWEIGHTS REVOLUTIONIZE SPORT OF MOTORCYCLING

A new sport is sweeping America—motorcycling! And Indian is enabling hundreds of thousands to enjoy it by bringing out new lightweight models that anyone, of any age, can ride in comfort and safety. Years ahead in design, incorporating ideas never previously heard of in motorcycles, the new Indian Arrow and Scout are truly revolutionary. If you've never ridden a motorcycle, you don't know what you're missing. See your Indian dealer today and find out!

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LEARN TO RIDE IN ONE EASY LESSON
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Please send me Catalogue containing complete information about your new Indian lightweight models.

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Here's "before and after" proof why You Should Simoniz Your Car!

Simoniz Kleener makes dull cars look new again Nothing equals wonderful Simoniz Kleener—for safely cleaning the finish and making cars look really new again. Anyone can do a professional job of Simonizing without a buffer—just inexpensive Simoniz and Simoniz Kleener. Use Liquid Kleener for a "quickie slick-up" or before applying Simoniz. Extremely dull cars require Paste Kleener. To protect the finish and make it last longer—follow up with famous Simoniz!

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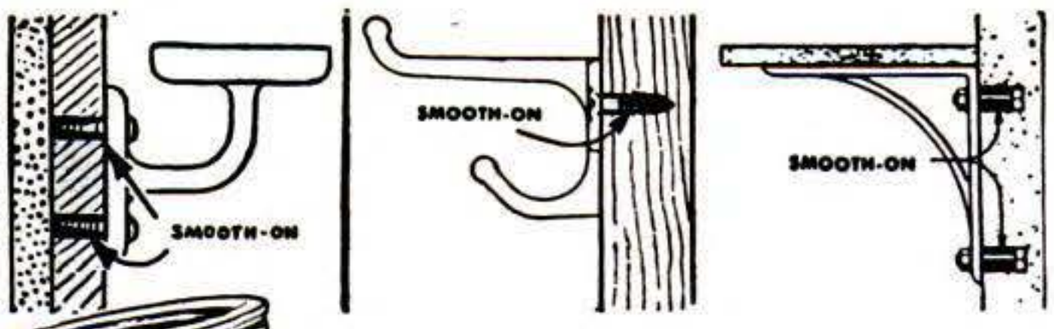

Loose Bathroom Fixtures Just Need SMOOTH-ON

Cup holders, shelf brackets, hooks, towel racks, soap dishes, etc. stay in place, once you anchor them with Smooth-On No. 1 Iron Cement. You apply it to screws and bolts and into the holes where they belong. Smooth-On hardens quickly and the repair stays tight, for Smooth-On expands a little as it sets. Get a 1¾-oz., 7-oz. or 1-lb. container of Smooth-On No. 1 and keep it handy not only for tightening loose parts and fixtures, but to stop leaks and seal cracks. If your hardware store hasn't Smooth-On, write us.

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Send for YOUR free copy of the 40-page Smooth-On Handbook of time-saving, money-saving repairs you can make in the home, on the car. Just mail us a postcard.

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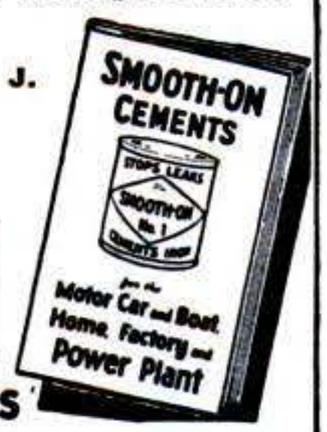

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THE IRON CEMENT OF 1000 USES

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HANDICRAFT KNIVES & TOOLS

Choice of experts in every art and craft field. A blade for every purpose—quickly interchangeable. Singly and in sets, 50¢ to $50.00. *(Slightly higher in Canada.)*

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DEMAND NEW DEPENDABLE CHAMPIONS FOR YOUR CAR

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

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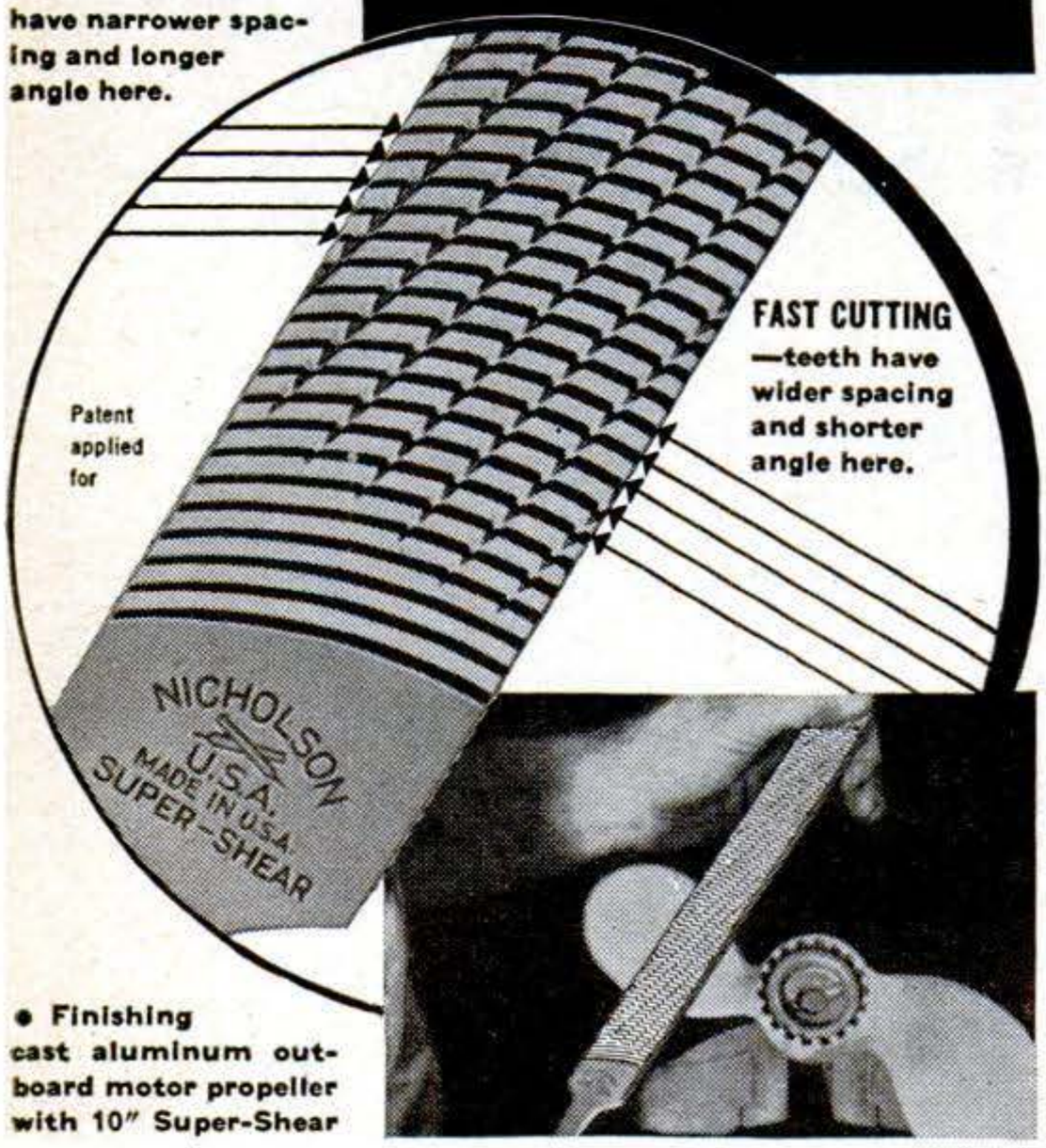
SUPER-SHEAR

. . . a new principle in a precision file for the industrial or amateur craftsman



• Finishing cast aluminum outboard motor propeller with 10" Super-Shear

A development by Nicholson, the Super-Shear is a curved tooth file that *smooths as it roughs.* Practically two files in one! Its extremely sharp teeth are *milled* in an arc that is off-center in relation to the axis of the file. Thus, when used with the usual overlapping right-to-left stroke, the Super-Shear "smooths out its tracks as it goes." Longitudinal serrations help to keep the file clear of chips; to overcome "chatter" and the tendency to run off the work.

Use Nicholson Super-Shear Files on the flat or convex surface of aluminum, brass, babbitt, bronze, copper, magnesium, cast iron, annealed tool steel; on plastics, hard rubber and hardwood.

Unwavering uniformity is assured under the sweeping Nicholson guarantee of *Twelve perfect files in every dozen.* And after it has given you long service, the Super-Shear may be resharpened at low cost. Available through good hardware and industrial distribution houses. For free booklet, "File Filosophy," write to:

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NICHOLSON FILES *FOR EVERY PURPOSE*

Keep Brushes like New

At Paint, Hardware, Dept., and 5 & 10c Stores
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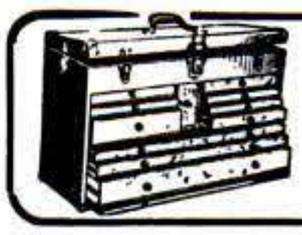

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HOW TO TAKE BETTER TIME EXPOSURES

Paint out the dark spots with your flashlight

...it's a trick that every expert photographer knows and uses. Your stationary lights are fine—but, no matter how many you use, they may leave dark, shadowed areas that show up on your finished picture. Avoid these amateurish black-outs by moving your flashlight beam back and forth across the dark areas while you're making the exposure. Do it just as a painter would use a brush. And be sure to keep your flashlight powered with "Eveready" batteries. Powerful, dependable, they outlast all other brands.*

..... A little light on the subject of the dark room!

Here's where your flashlight's handy, too! Wrap 2 or 3 layers of dark green or red cellophane over your flashlight lens and you have a safe portable light to use in your dark room. It *won't* streak film and it *will* help you to locate objects and to operate conveniently.

***In general-purpose 4-ohm intermittent tests**

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OUTLASTS ALL OTHER BRANDS!

Who thought up this test that takes the guesswork out of buying flashlight batteries? The American Standards Association, no less! ... And this is the test that *most closely approximates the average use* you give batteries in *your own* flashlight. Be bright tonight! Buy "Eveready"!

The trade-mark "Eveready" distinguishes products of

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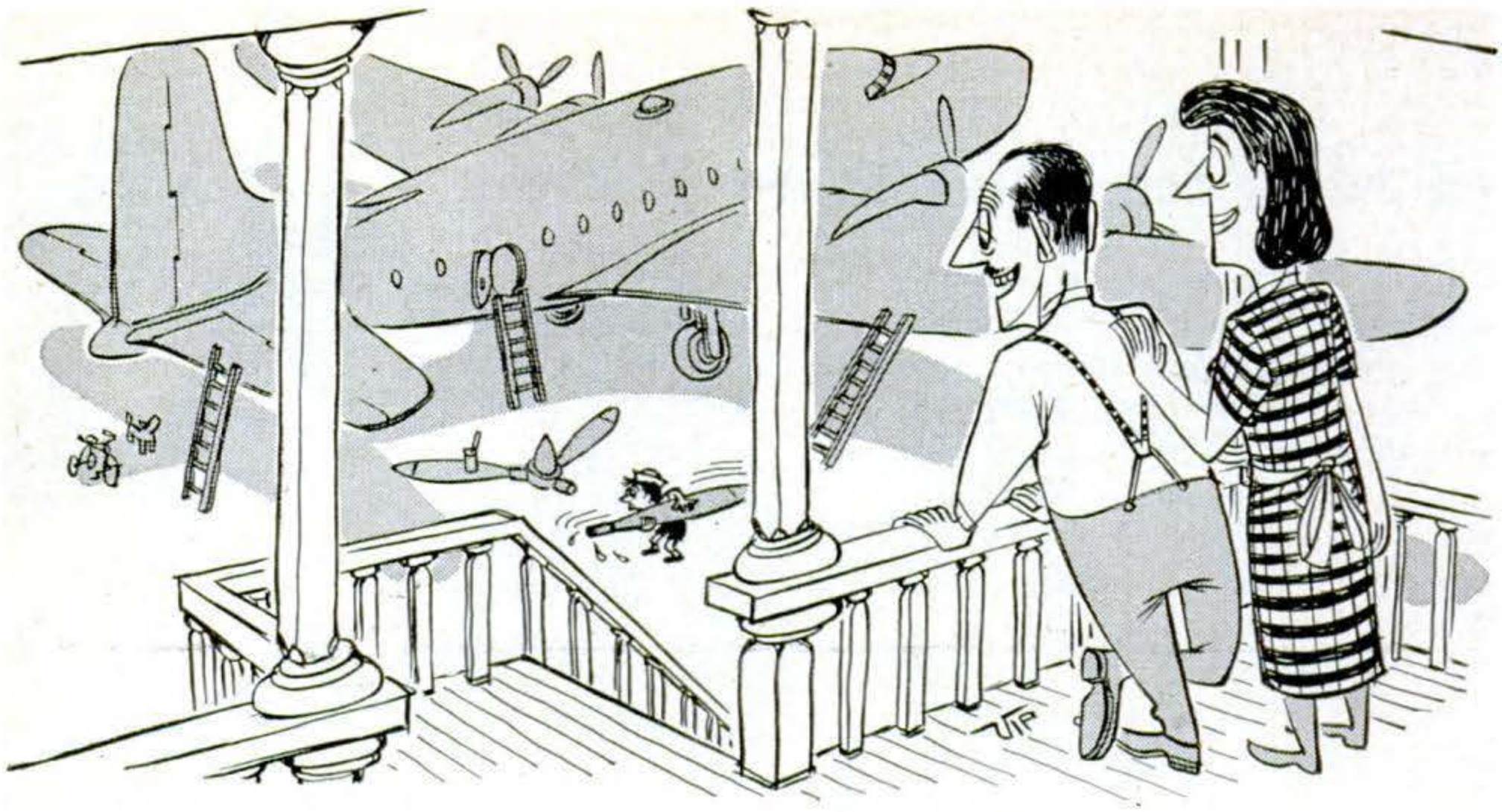

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When you want a wood-to-wood bond that will really hold... remember Weldwood Glue. It's quick to mix... easy to use... tremendously strong... stain-free... rot-proof... and permanent. At hardware stores, lumber yards, chain stores, in 15¢, 35¢, 65¢, 95¢ and larger sizes.

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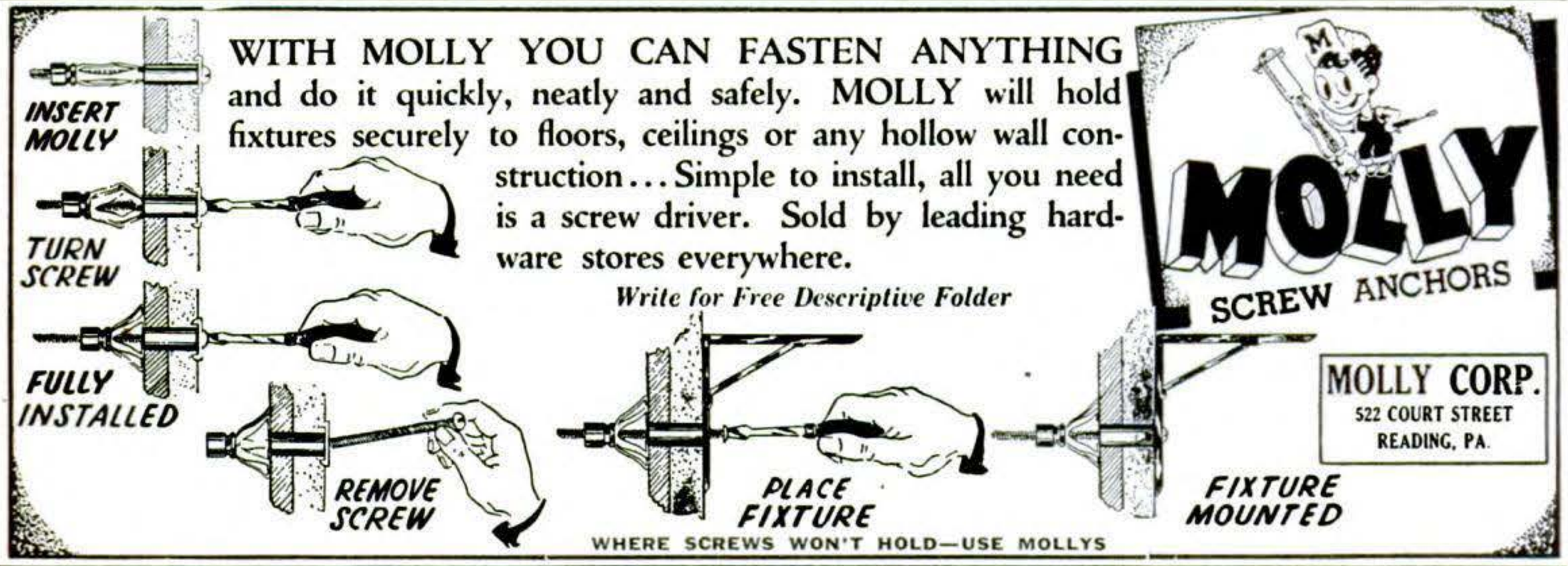

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For Repairing, Hardfacing Building Equipment

Easy to weld. Arc striking is now automatic. The instant the electrode touches the work, "Lincwelder's" exclusive "Arc Booster" blasts the end of the electrode with an extra burst of welding current to start the arc. Eliminates electrode sticking and bothersome scratching formerly needed to get the arc started.

Ideal for rural power lines and for use on farms. Draws less than 37 amps. when welding at 180 amps. Approved by power companies and REA. *Safe to operate.* Open circuit voltage never exceeds 52 volts.

Lowest priced welder. Has many high quality features found only in Lincoln industrial welders . . . *yet sells for only $150 . . . lowest cost of any welder of its capacity.*

Full details in Bul. 370. See your local Lincoln Weldealer or write The Lincoln Electric Company, Dept. 313, Cleveland 1, O.

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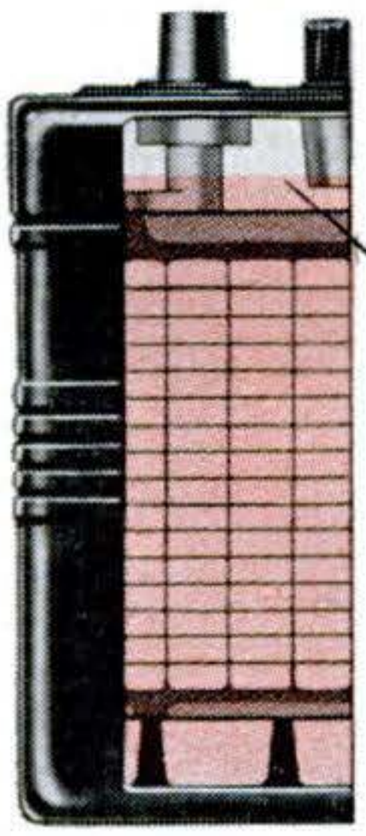
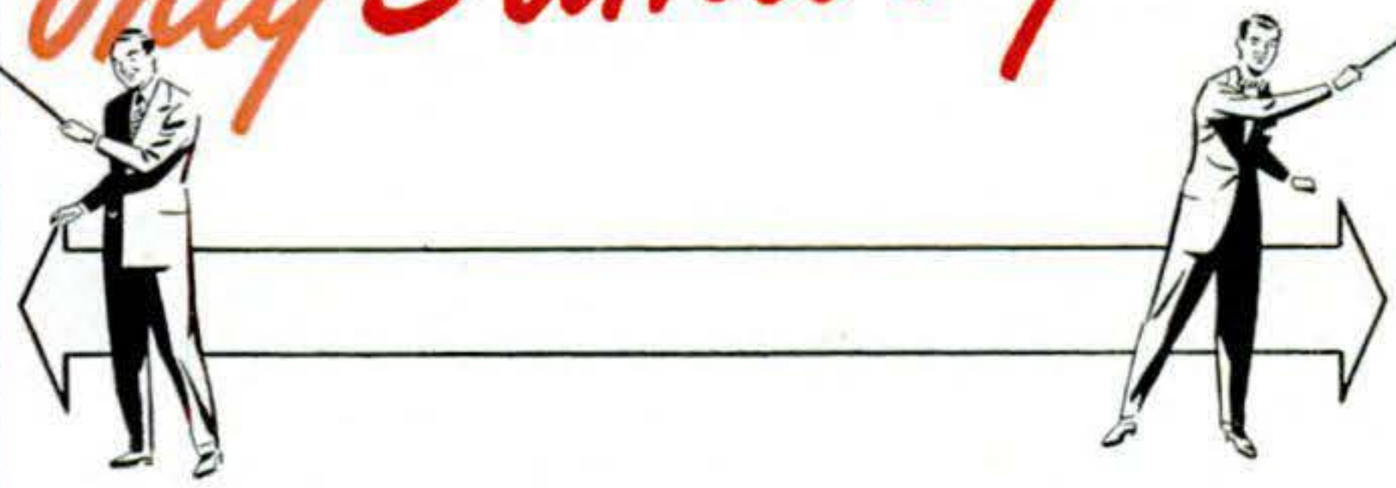
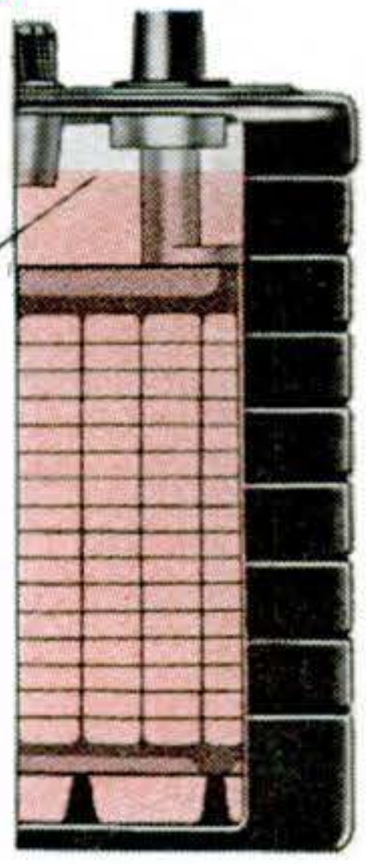
Here's Why New AUTO-LITE STA-FUL Battery

...needs water only 3 times a year*



ORDINARY BATTERY





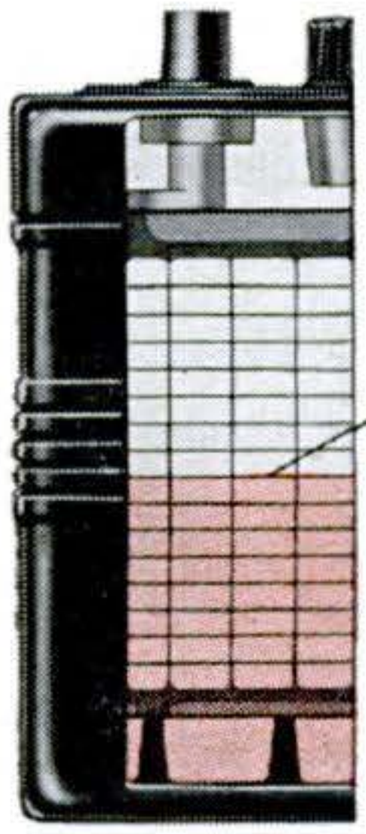
STA-FUL BATTERY

HERE'S WHAT HAPPENS INSIDE AN ORDINARY BATTERY

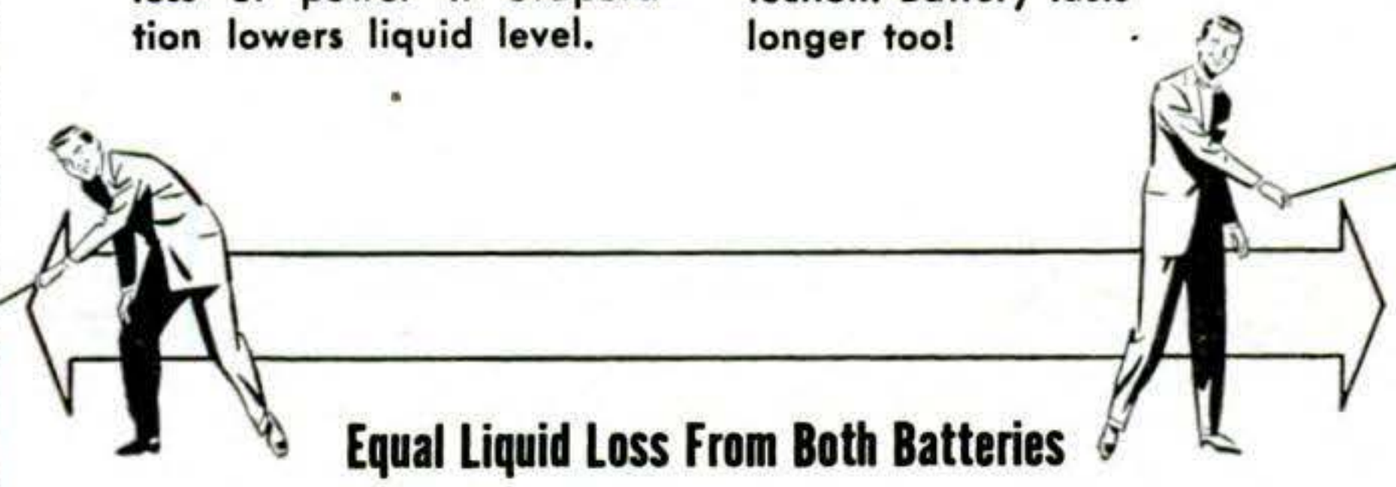
This battery is now full. Small liquid reserve gives battery plates little protection against damage and loss of power if evaporation lowers liquid level.

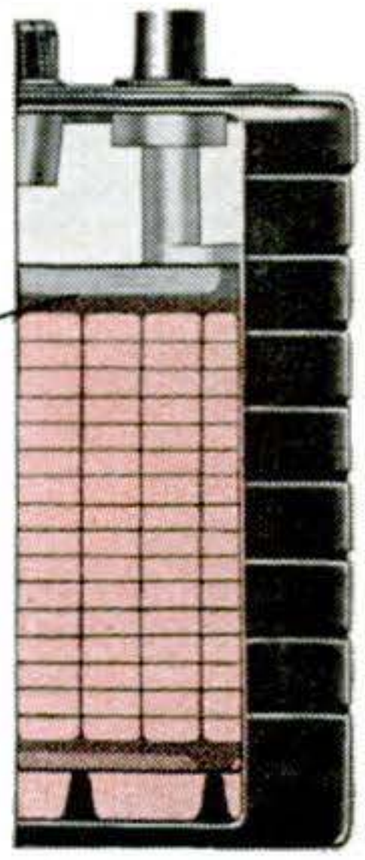
HERE'S WHAT HAPPENS INSIDE AUTO-LITE "STA-FUL"

The new "Sta-ful" has more than 3 times the liquid reserve of ordinary batteries. Gives its plates added protection. Battery lasts longer too!



ORDINARY BATTERY





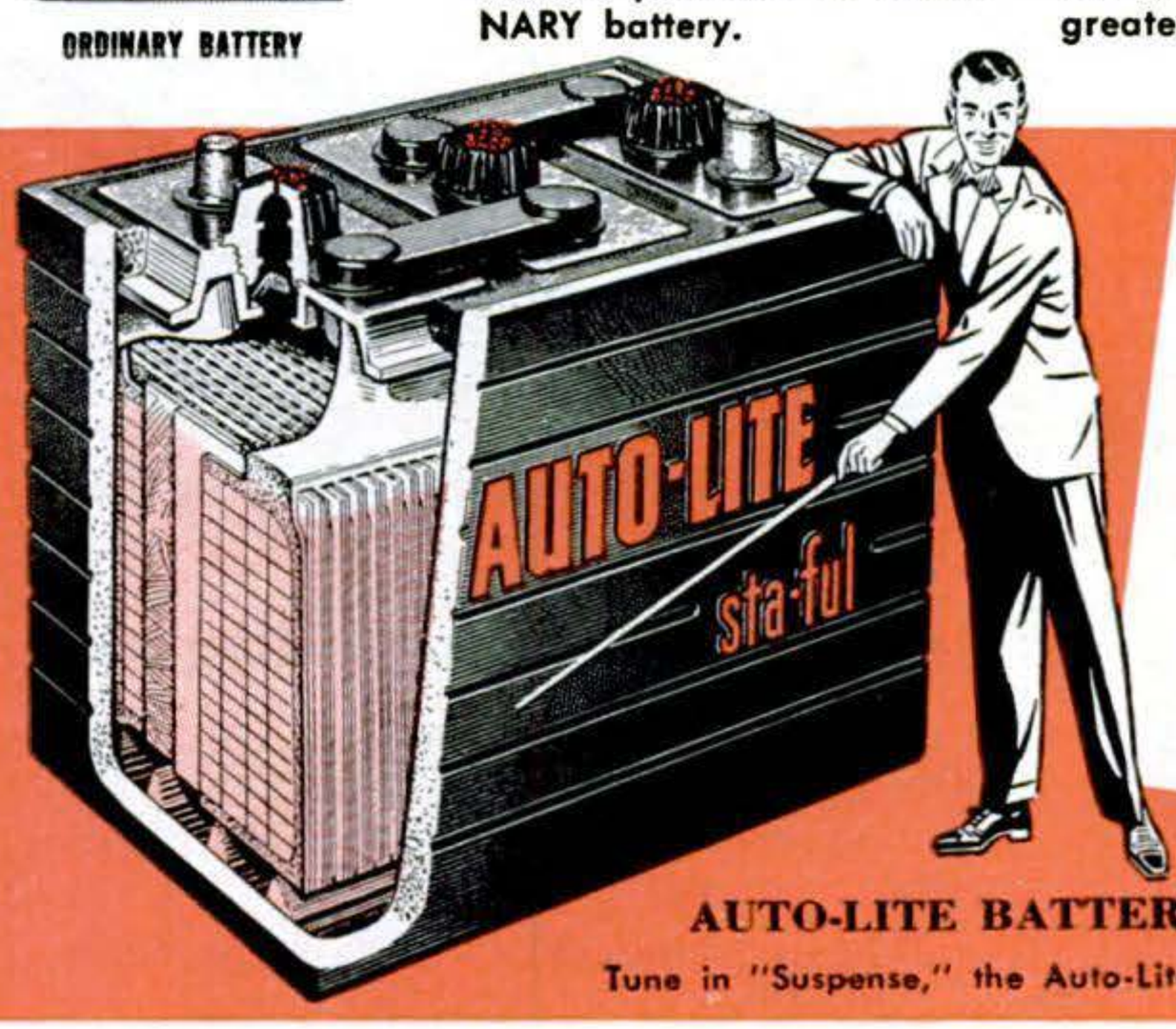
STA-FUL BATTERY

Equal Liquid Loss From Both Batteries

Plates at the left are now exposed and inactive because of the small liquid reserve provided in ORDINARY battery.

The "Sta-ful" Battery plates are still kept fully covered and protected because of the more than 3 times greater liquid reserve.

*In normal car use



Why the "Sta-ful" Design Is Possible

Fibre-glass mats help to keep the power-producing material from shedding—add to battery life. This makes possible the "Sta-ful" construction with its smaller sediment well which permits room for a liquid reservoir with over 3 times the usual capacity at the top of the battery. Make your next battery an Auto-Lite "Sta-ful."

AUTO-LITE BATTERY CORPORATION, Toledo 1, Ohio

Tune in "Suspense," the Auto-Lite Radio Show—Thursdays, 9:00 P.M.—E.T. on CBS

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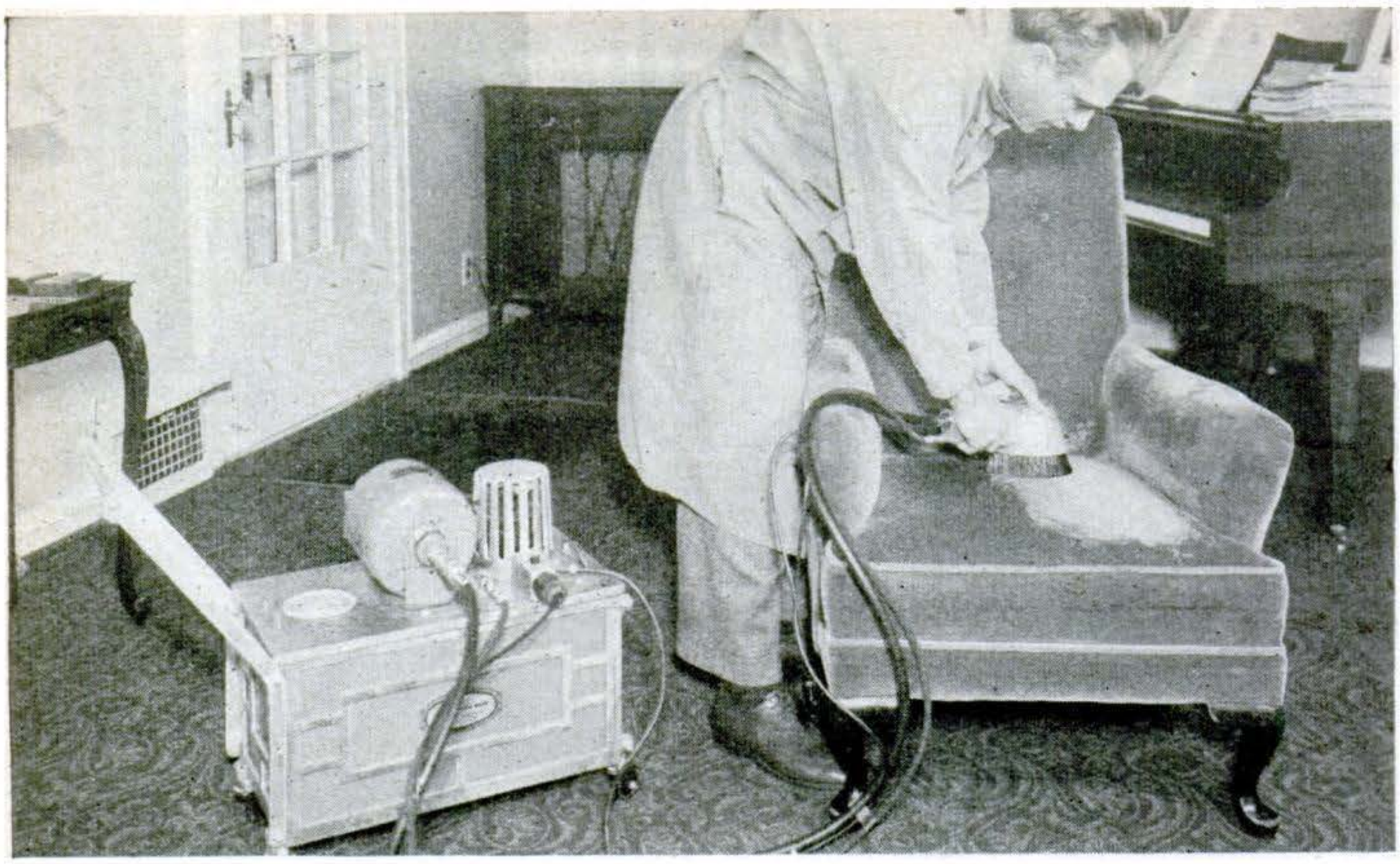
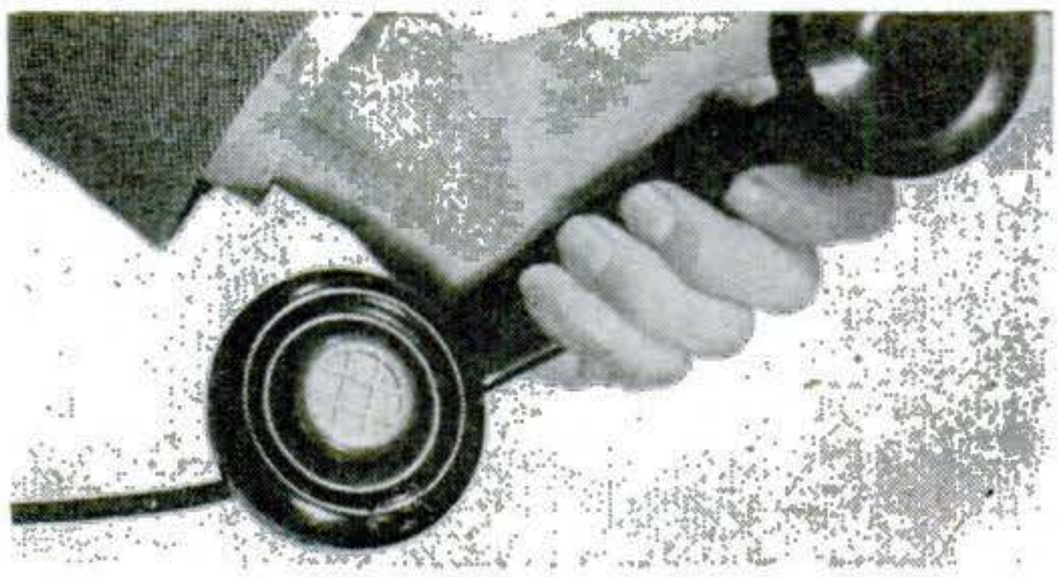


Shampooer Works Fast

THE new portable, lightweight shampooer shown above is said to give your upholstery a beauty treatment three times as fast as any other method. The cleaning solution, controlled by a handle valve, is forced out through its magnesium head in a fine spray of dry suds. The brush, mounted at the end of an 8-ft. flexible shaft, is driven by a ¼-hp. motor. The machine is made by Certified Equipment Co., of Cleveland.

Arms Grip Brush, Razor

YOU'LL never have to grope around for your shaving equipment with the Mazwell Shave-King ®, shown at left. Patented locking arms grip any size brush and razor and hold them ready to hand. The hollow base is a receptacle for used blades.



Disk Drubs Phone Germs

SNAP a Safti-Khlor ® disk in your telephone mouthpiece, say its makers, and you can stop worrying about germs there for the next four months. The flat plastic disk is said to kill 40 to 82 percent of pathogenic germs in a minute—without blocking your voice.

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NOW... LIGHT WHEN YOU NEED IT!

Ray-O-Vac LEAK PROOF batteries stay fresh for years!

(because they're Sealed in steel!)

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Guarantee: If your flashlight is damaged by corrosion, leakage, or swelling of this battery, send it to us with the batteries and we will give you FREE a new comparable flashlight with batteries.

Ask for Ray-O-Vac Leak Proofs

Buy Spares... *they stay fresh*

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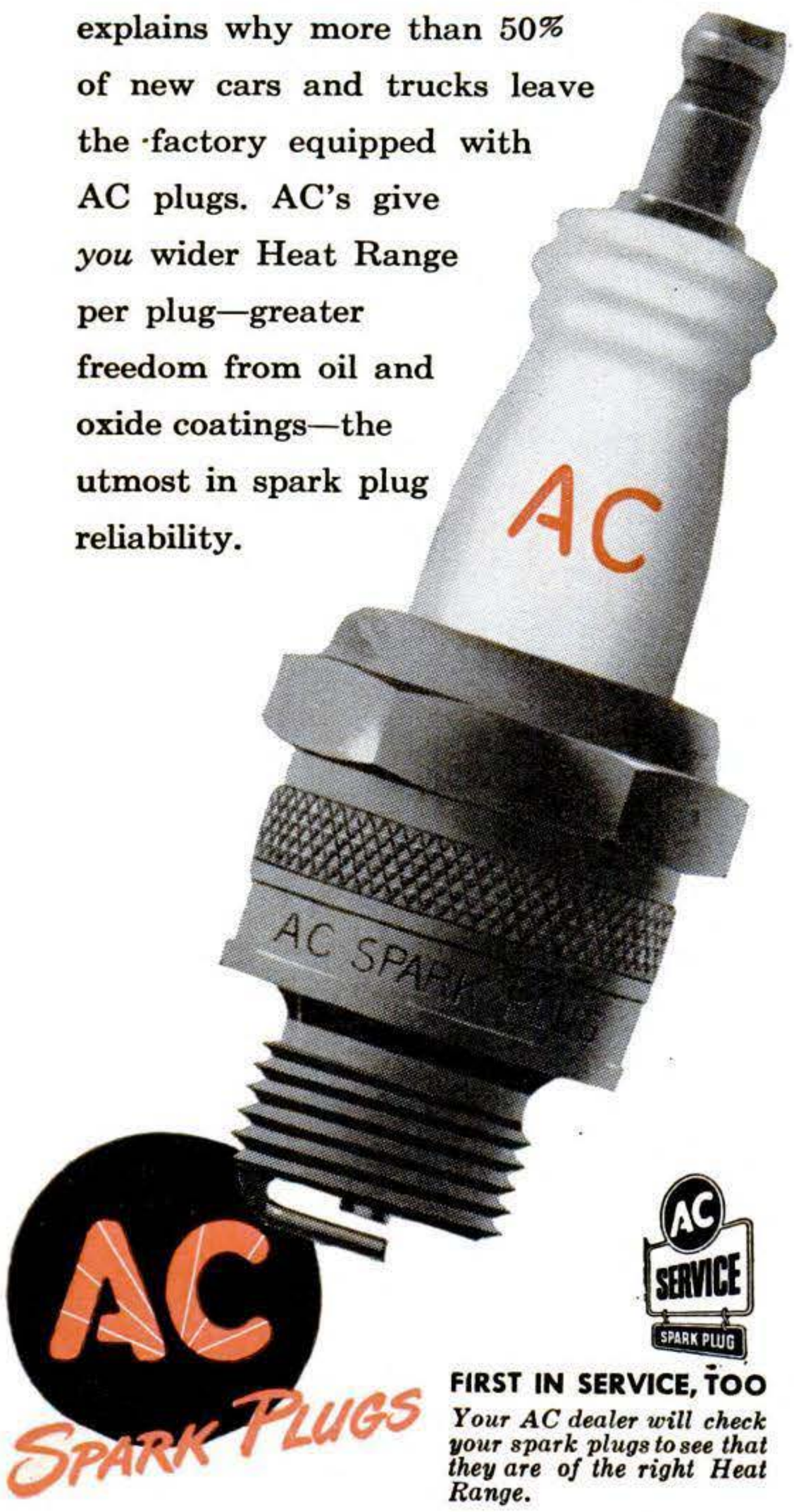
in Reliability

AC Spark Plugs are engineered to the equipment specifications of car and truck manufacturers—which explains why more than 50% of new cars and trucks leave the factory equipped with AC plugs. AC's give *you* wider Heat Range per plug—greater freedom from oil and oxide coatings—the utmost in spark plug reliability.



AC SPARK PLUGS

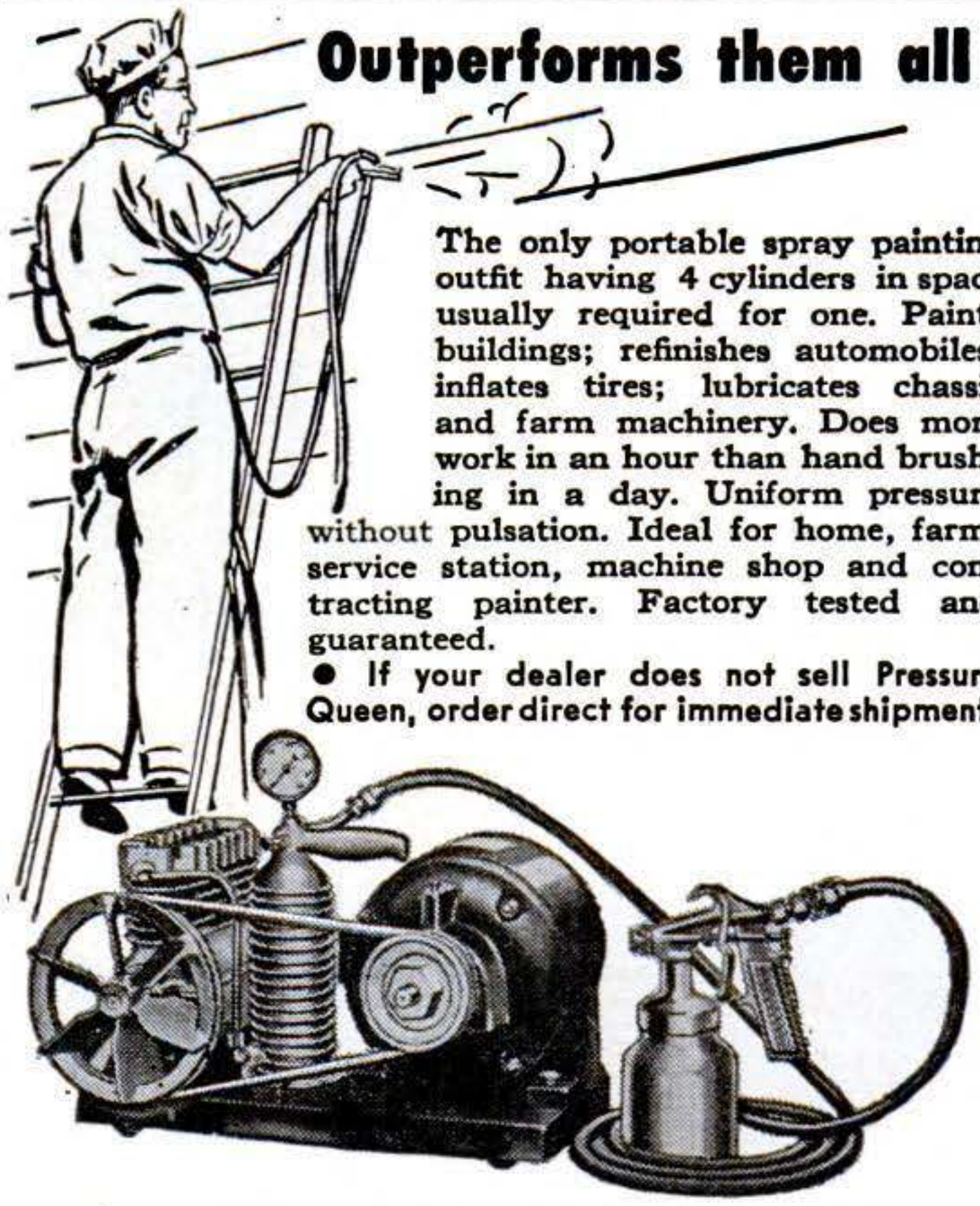
AC SERVICE SPARK PLUG

FIRST IN SERVICE, TOO

Your AC dealer will check your spark plugs to see that they are of the right Heat Range.

PRESSURE QUEEN

Outperforms them all



The only portable spray painting outfit having 4 cylinders in space usually required for one. Paints buildings; refinishes automobiles; inflates tires; lubricates chassis and farm machinery. Does more work in an hour than hand brushing in a day. Uniform pressure without pulsation. Ideal for home, farm, service station, machine shop and contracting painter. Factory tested and guaranteed.

- If your dealer does not sell Pressure Queen, order direct for immediate shipment.

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By Test: Increased Acceleration by 26%
Increased Power and Speed by 11%

All DIXIE-WESTERN manifolds are brightly polished cast aluminum.

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SAVE TIME, WORK, MONEY!

SHAW "DU-ALL" and "PEPPY PAL" TRACTORS

These rugged walking or riding tractors are ideal for farm, truck garden, orchard, poultry farm. Operate on a few cents an hour. A child can handle them.

DO DOZENS OF JOBS Both riding and walking tractors quickly and easily plow, cultivate, harrow, disk, bulldoze, spray, haul, grind, saw wood, etc.

LOW FACTORY PRICES Buy direct or through your dealer. Year's guarantee!

RIDING TRACTORS 4 models from 5 to 12½ H.P., 58 in. wheelbase, 36 to 52 in. wide, 24 in. plant clearance. Hand or electric starter. Walking Tractors 1½ to 3 H. P.

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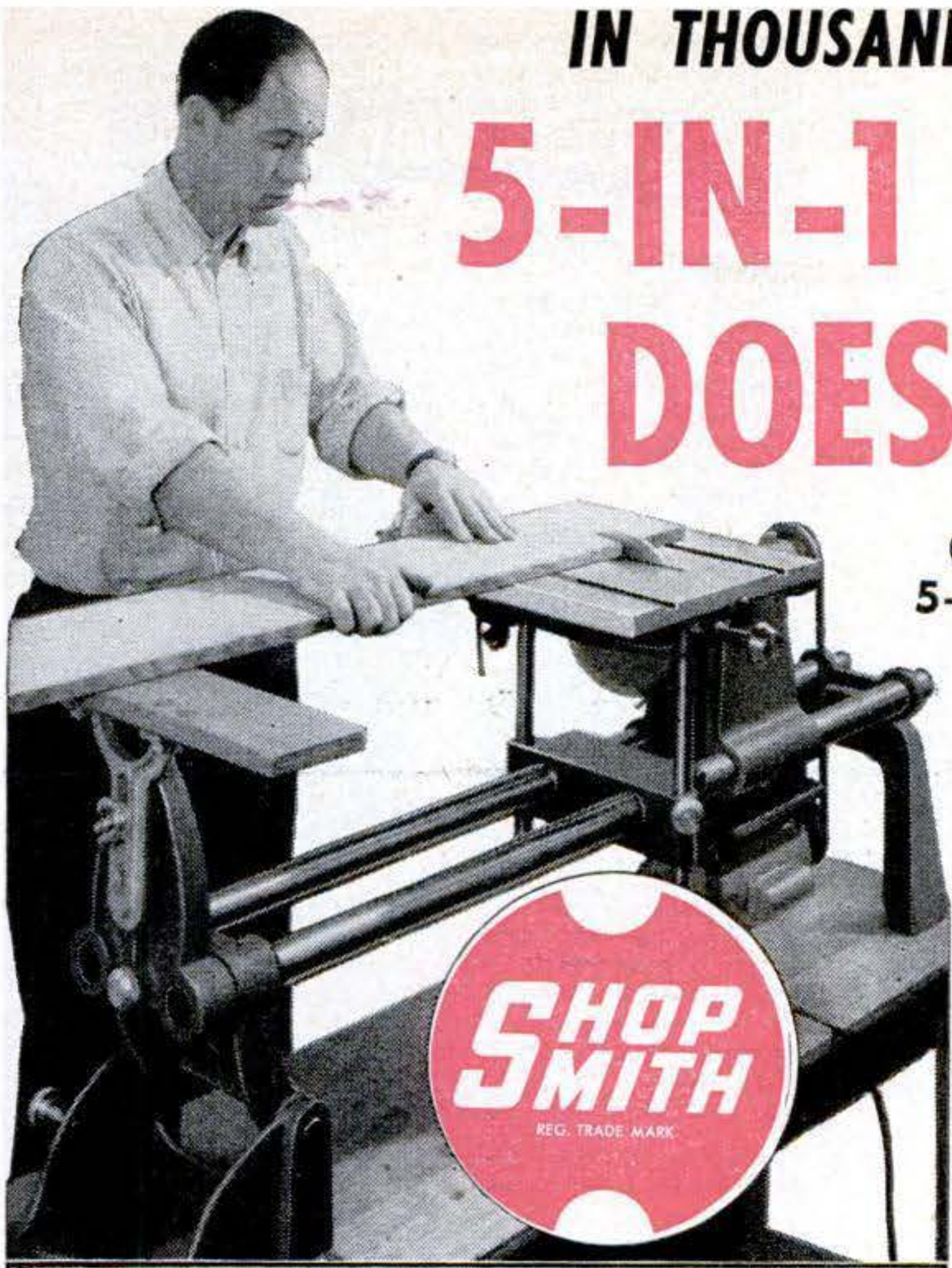
5-IN-1 SHOPSMITH DOES BIG JOBS



COMPLETE 5-IN-1 TOOL $159.50 With special ½ H. P. ball bearing motor $195.50

Do your present power tools balk at big stock? Do they hold you back from the jobs you really want to do?

Then take a look at *SHOPSMITH* — the new, big capacity circular saw, wood lathe, disc sander, vertical and horizontal drill press all in one. Each has big capacity . . . built to husky specifications. And see what big jobs *SHOPSMITH* does in limited home workshop space.

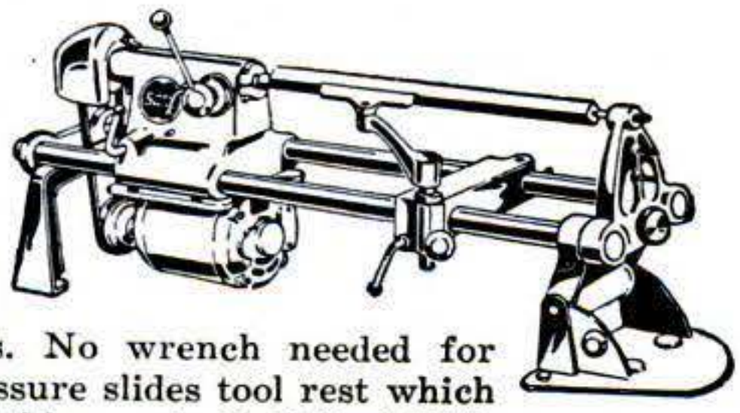
With all its big capacity and rugged construction *SHOPSMITH* stands just 59″ long by 18″ wide.

Check *SHOPSMITH* against your woodworking needs. See it demonstrated. For name of nearest *SHOPSMITH* dealer, and free folder, write **Department M, Magna Engineering Corporation, 465 California Street, San Francisco 4, California.**

1. SHOP SMITH AS CIRCULAR SAW Has 8″ saw blade; depth of cut 2¼″; 14½″ x 17″ table, with extension 54″ x 17″; up to 46″ between blade and fence . . . so you can cut to center of 92″ board. Table tilts to any angle — positive lock. Takes work on either side of blade. New principle provides micro-adjustment of distance between fence and saw blade.

Includes: 8″ combination saw blade and arbor. Table extension. Mitre gauge. Rip fence. Saw guard. *And in less than one minute you can change from saw to lathe, disc sander or drill press!*

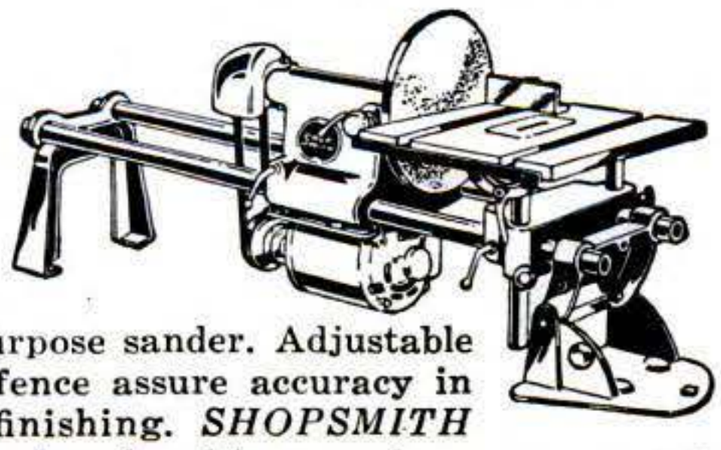
2. SHOP SMITH AS WOOD LATHE



Has 34″ between centers. Fifteen-inch swing. Also turns light metals, plastics. No wrench needed for setup. Finger-tip pressure slides tool rest which locks in position. Variable speeds. Quill feed 4¼″.

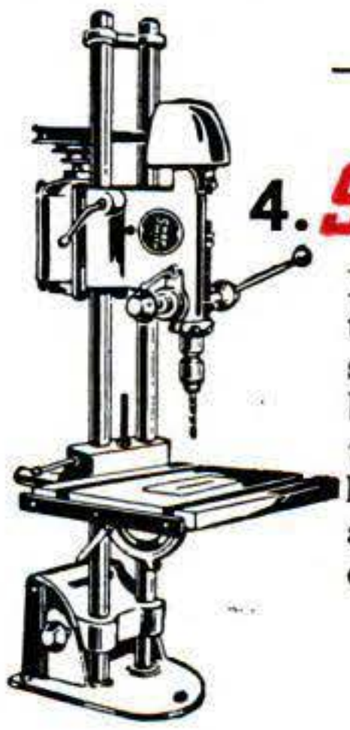
Includes: Tool rest. Drive center. Cup center. *SHOPSMITH is precision-machined, factory-tested for accurate work.*

3. SHOP SMITH AS DISC SANDER



Has 12″ disc; 14½″ x 17″ tilting table . . . supplies more work support than single-purpose sander. Adjustable mitre gauge and rip fence assure accuracy in squaring, mitering, finishing. *SHOPSMITH* discs can be removed and replaced in seconds . . . so you can sand a job with various grits.

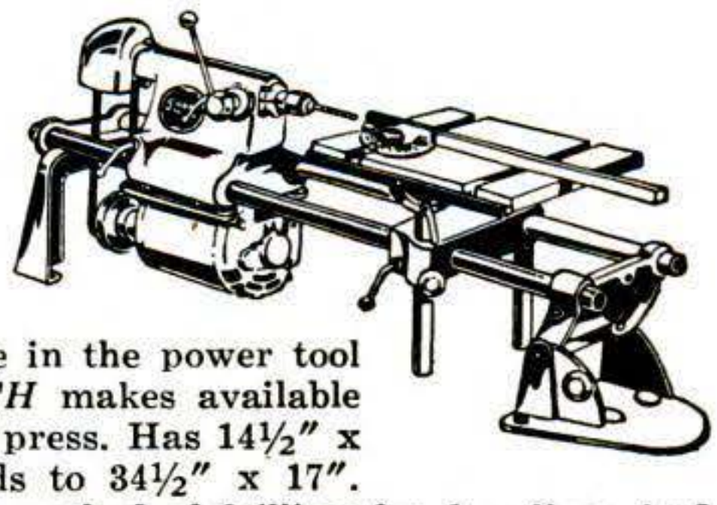
Includes: 12″ disc; balanced dynamically and statically. Mitre gauge. *SHOPSMITH is sturdily constructed . . . will take all the wear and tear you would ever give it.*



4. SHOP SMITH AS VERTICAL DRILL PRESS

Drills to center of 15″ circle. Has 27″ table-to-chuck clearance. Drills big stock. Has 4 grease-sealed Fafnir ball bearings. Quill can be fed from *left or right* side. Spindle: ⅝″ Dia., 6 spline, hardened tip. Spindle feed: 4¼″. Variable speeds. *Includes:* ½″ Jacobs key chuck. Fence.

5. SHOP SMITH AS HORIZONTAL DRILL PRESS



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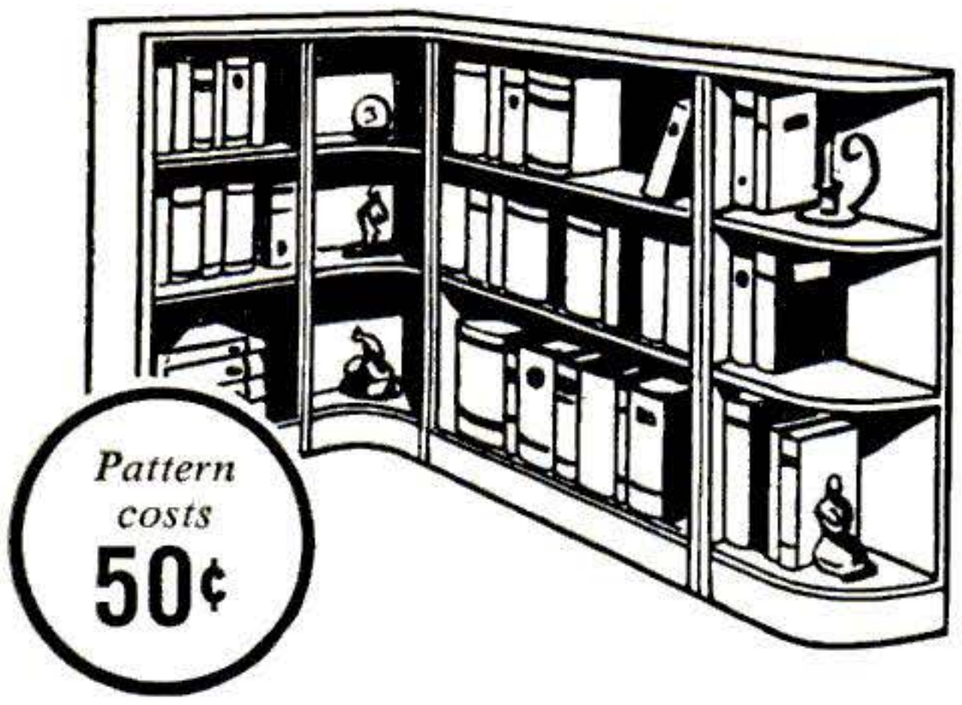

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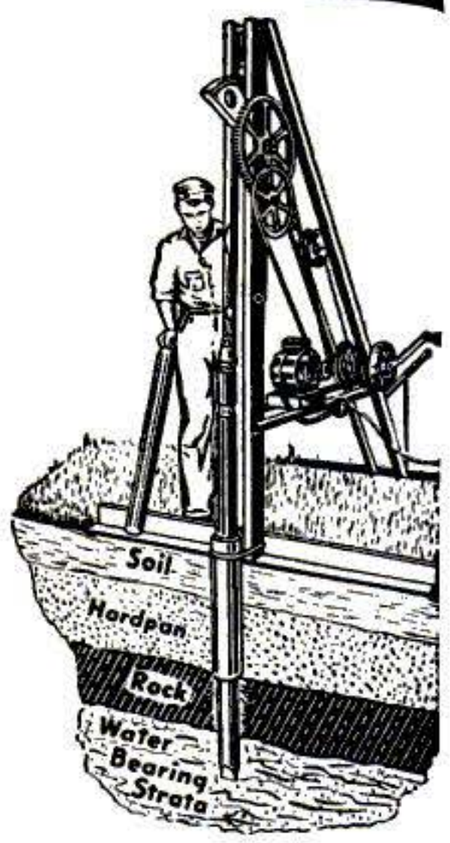

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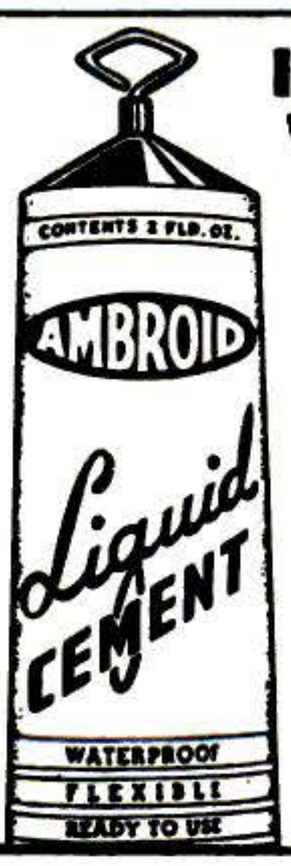

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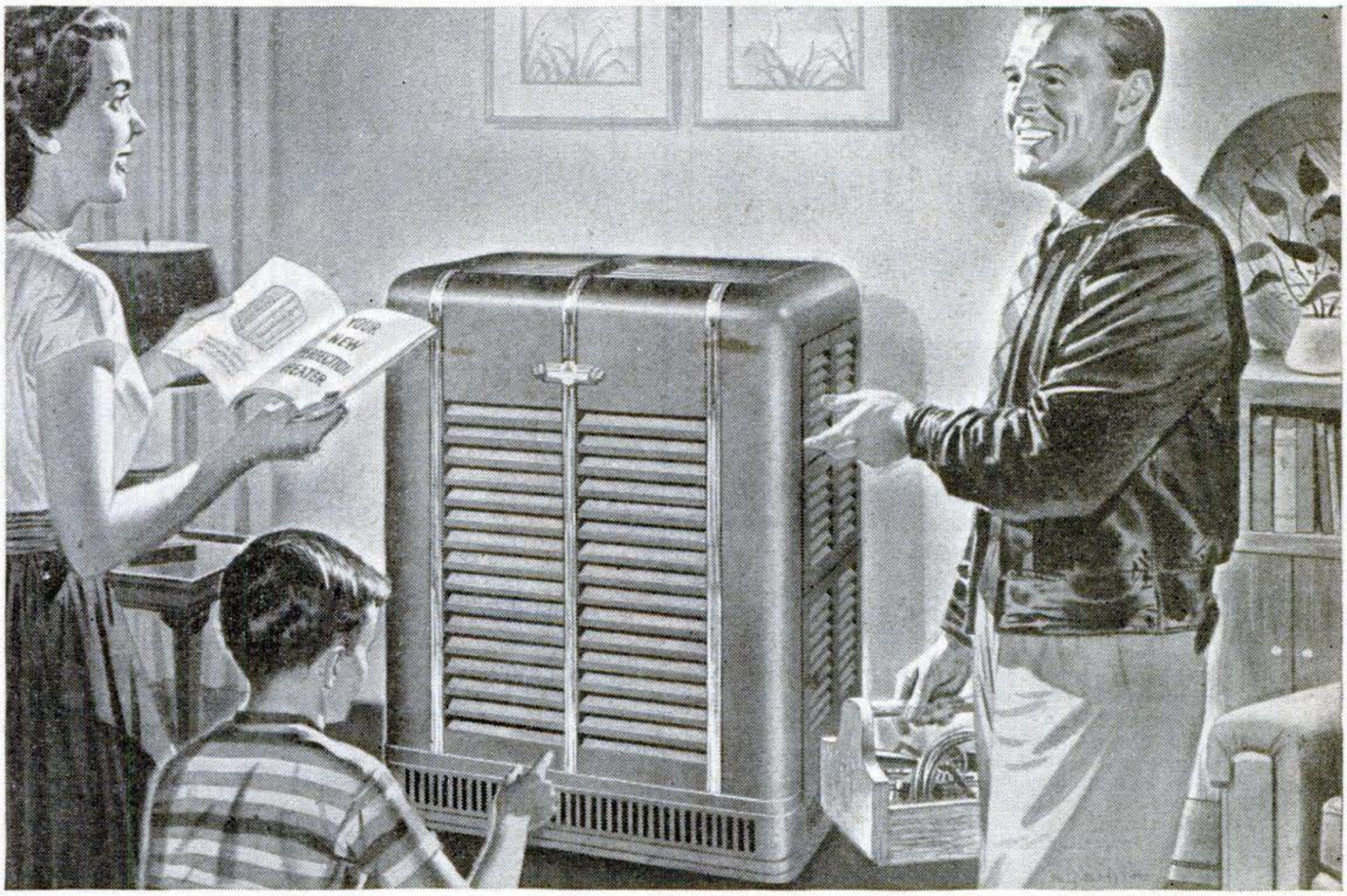

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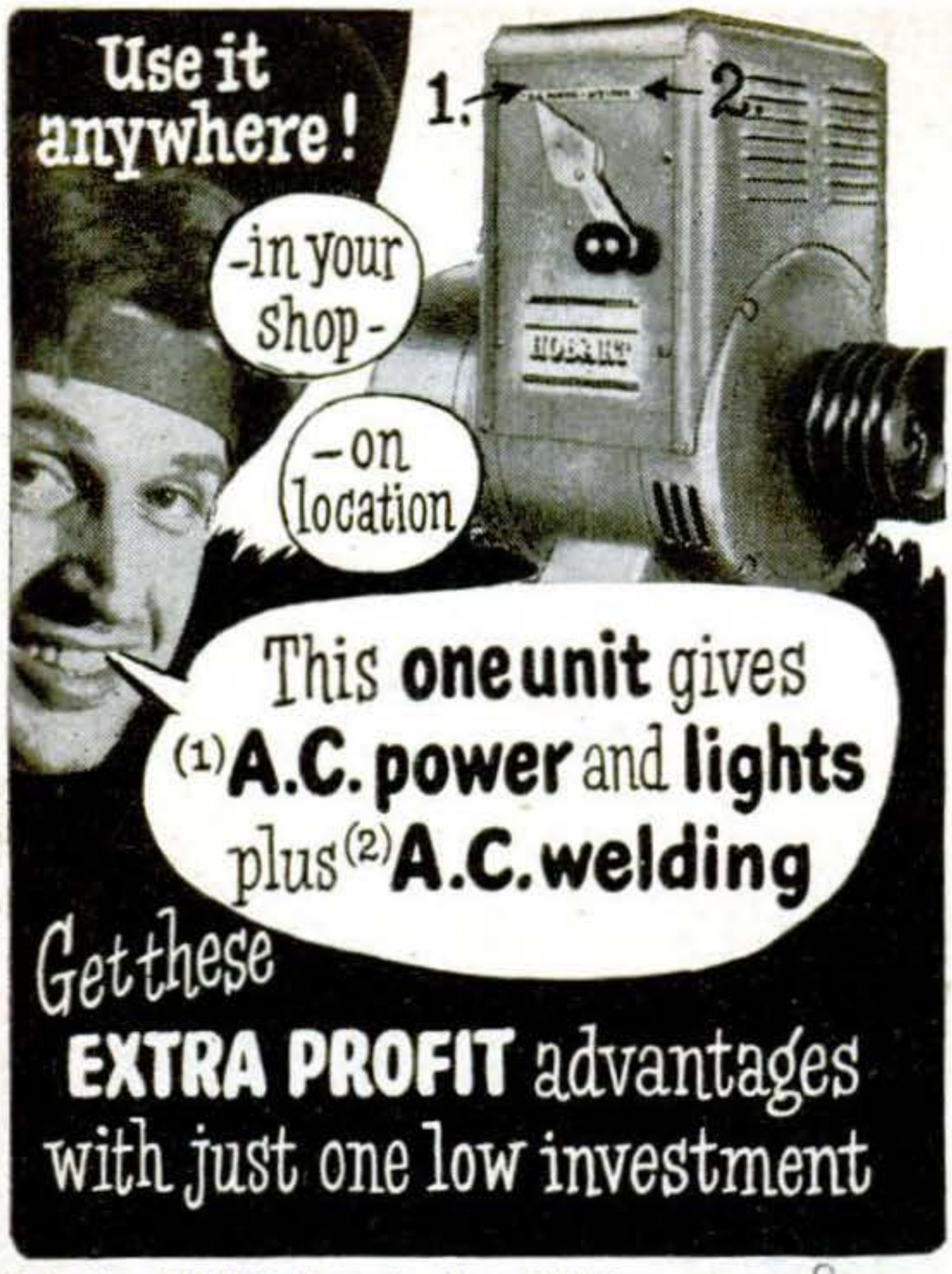

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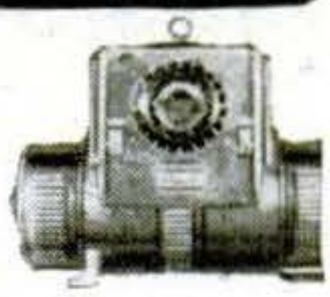
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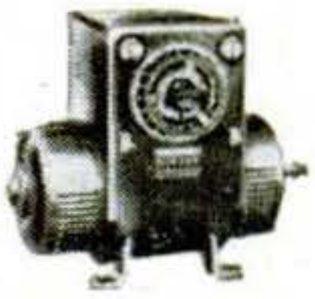
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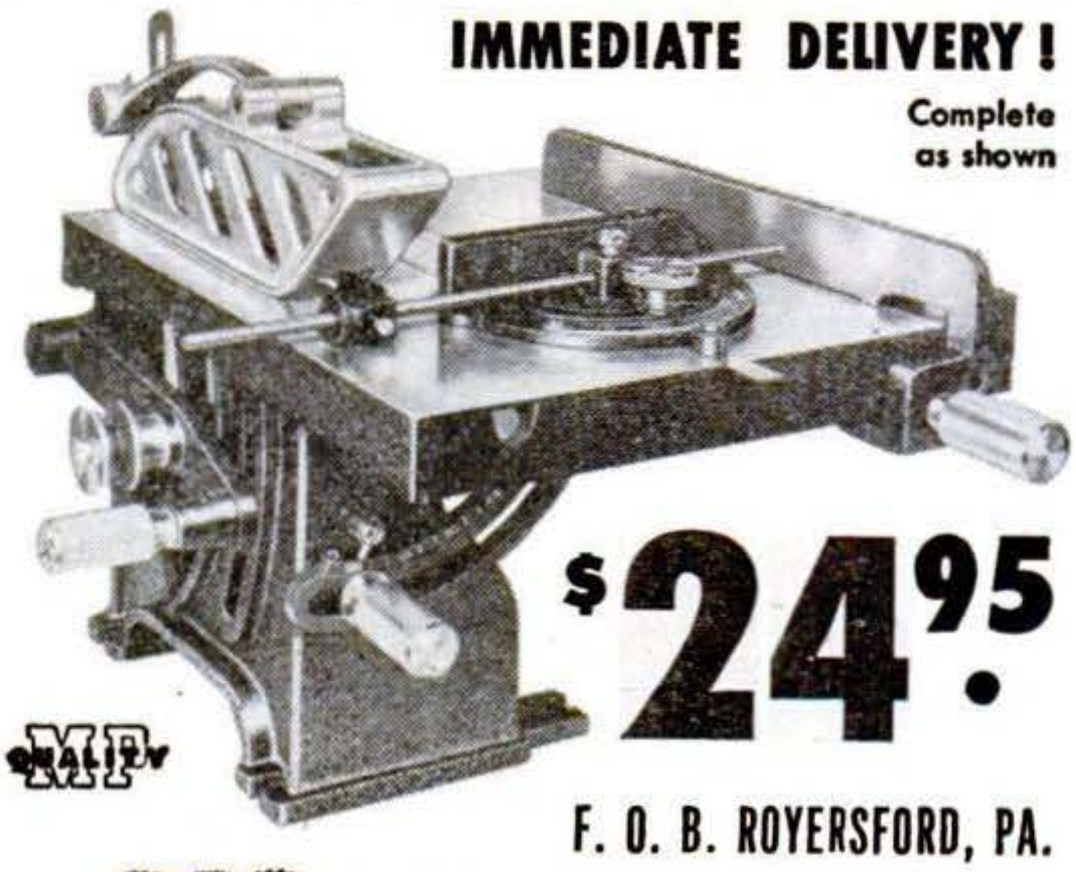

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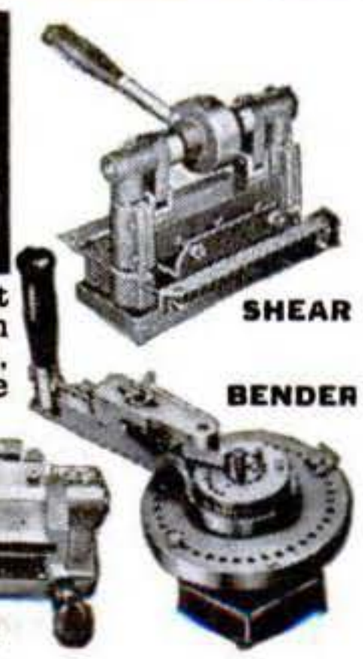

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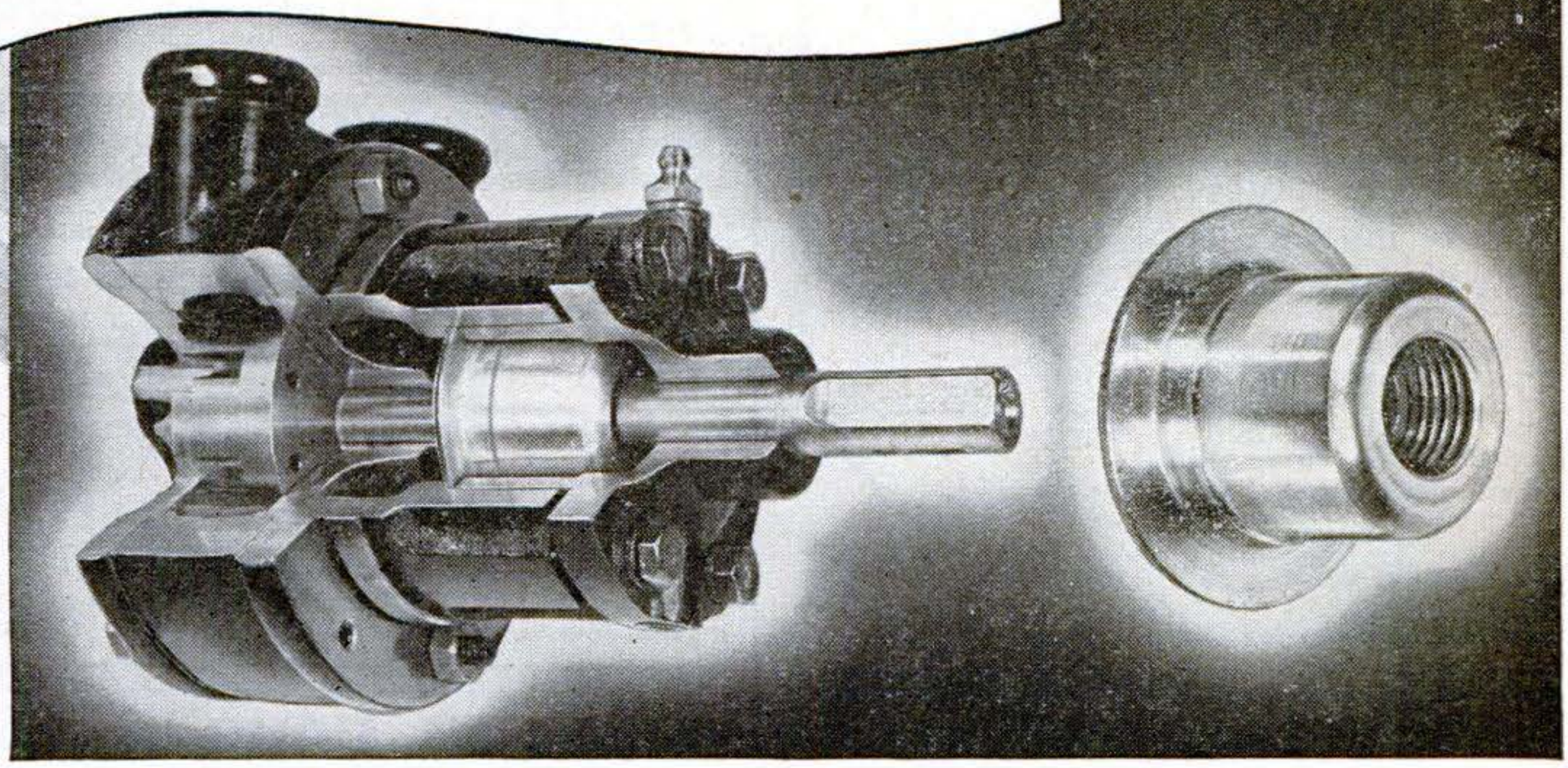

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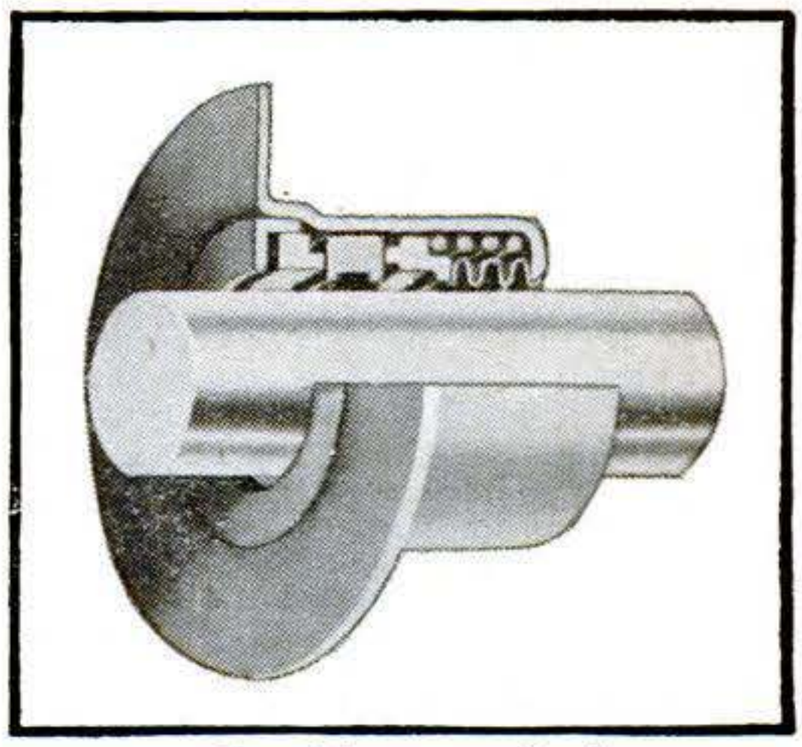

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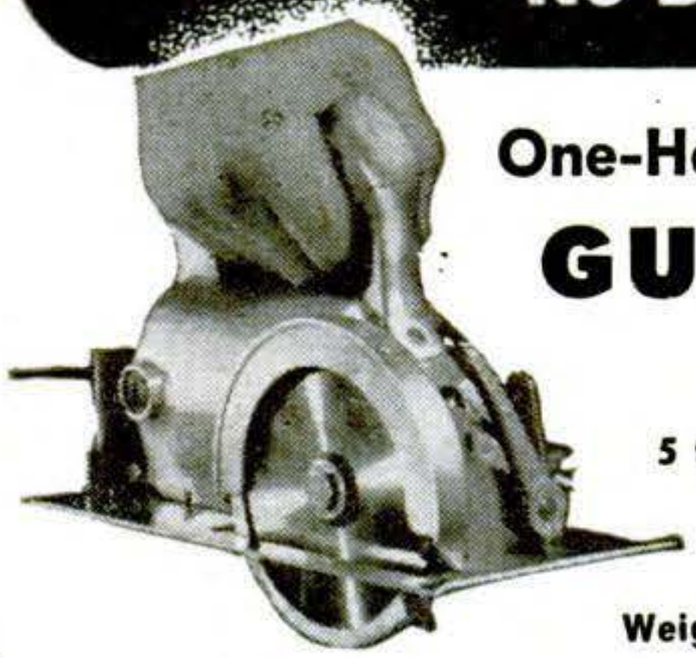

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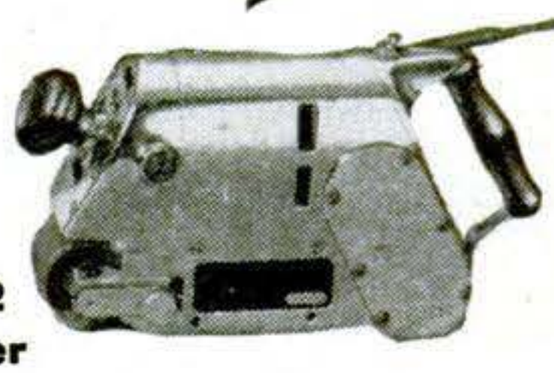

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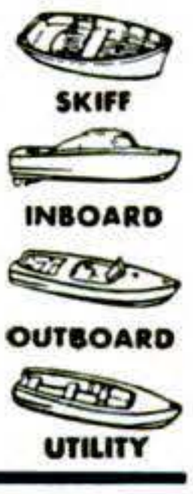

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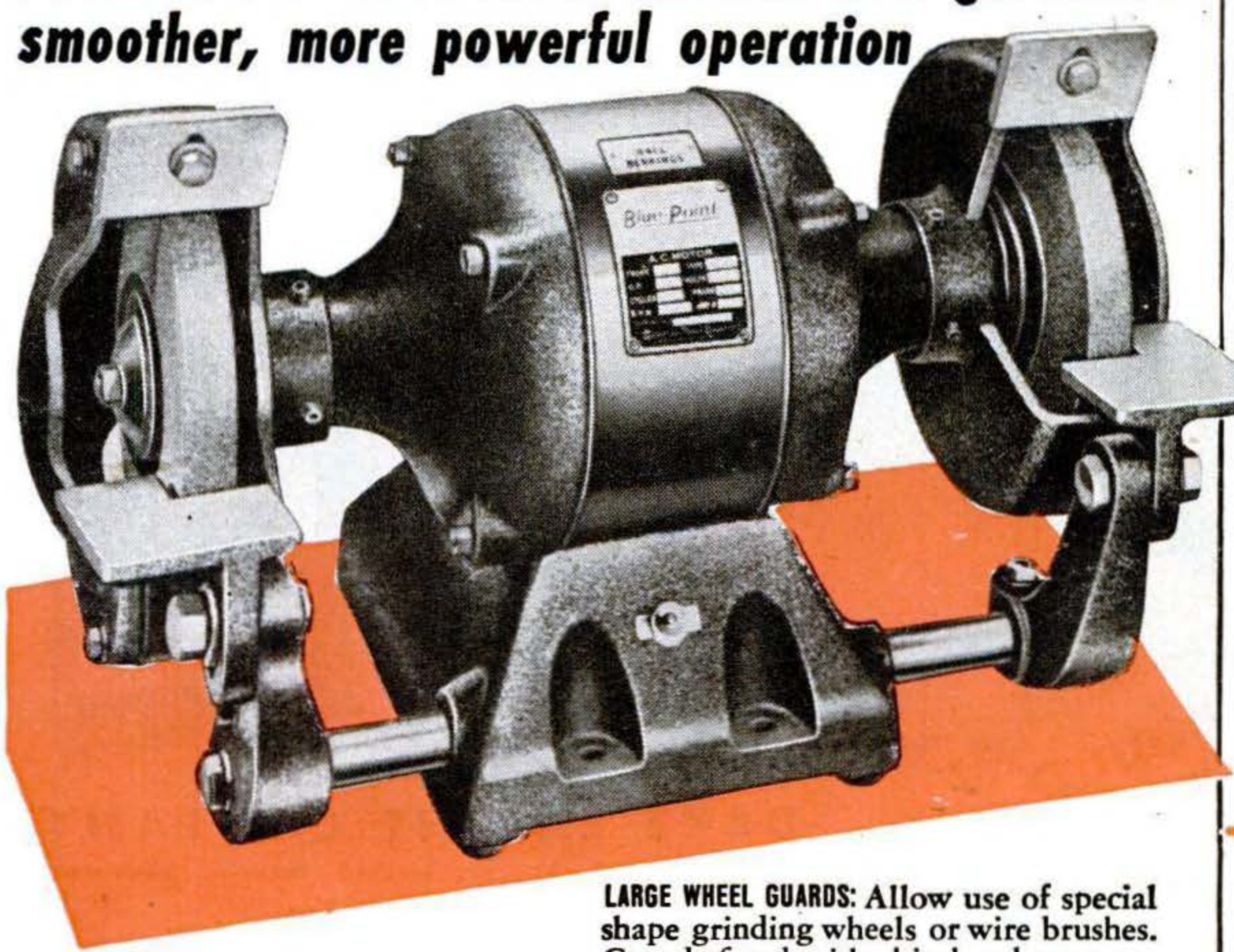

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Quickly trues, cleans grinding wheels. Protective hood over cutters. Includes extra set of easily inserted cutter wheels.

EYE SHIELDS
Thick safety glass for clear vision, protection. Sturdy aluminum frame. Easily attached to grinder.

COMPLETELY ENCLOSED MOTOR: Super powered, precision balanced motors enclosed to prevent dirt, grit, etc. from entering.

BALL BEARING CONSTRUCTION: Oversize grease sealed ball bearings used throughout, assure smooth, motor operation.

LARGE RUGGED BASE: Rubber feet provides solid mounting free from vibration. Recessed bolt openings for permanent mounting.

INDUCTION RUN MOTOR: Develops less heat in the windings — more desirable for continuous operation.

LARGE WHEEL GUARDS: Allow use of special shape grinding wheels or wire brushes. Guards fitted with chip breakers.

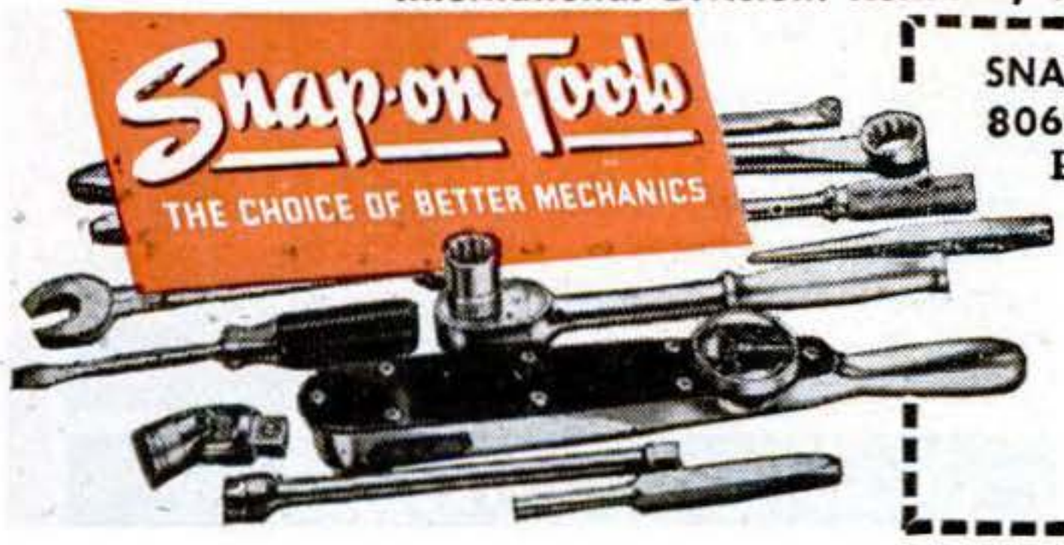
BELL TYPE CONSTRUCTION: Provides full clearance so that long straight pieces may be ground across the face of the machine.

STURDY TOOL RESTS: Adjustable for any type of work with ample take-up for wheel wear.

CAPACITOR START MOTOR: Uses low starting current . . . actually less than 15 amps. is consumed.

VOLTAGE: Standard models of the 1/3 H.P. and ½ H.P. grinder require 110 Volts, 50/60 cycle AC current. Standard 1 H.P. grinder takes 220 Volts, 50 or 60 cycle AC current.

SNAP-ON TOOLS CORPORATION
8060-1 28th AVENUE • KENOSHA, WISCONSIN
International Division: Kenosha, Wis., U. S. A.



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Please send me more details about Bench Grinder and accessories.

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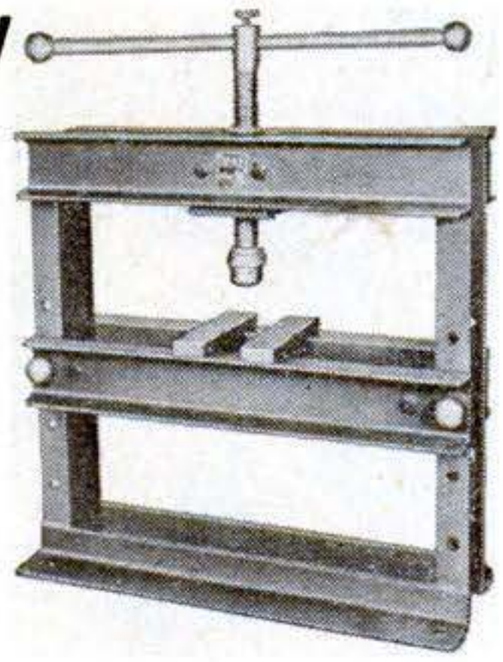

Ten-ton press, ideal for all kinds of pressing, separating, straightening, and bending jobs. Ample capacity for home shops. Easily adjustable table takes work up to 18 inches wide and 11½ inches high. Roller-bearing ram for long life. Send for free bulletin showing press and wide variety of accessories.

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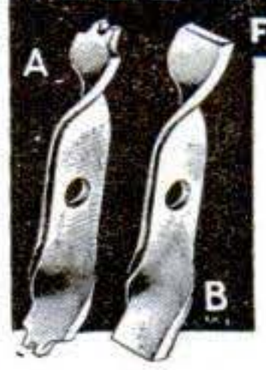

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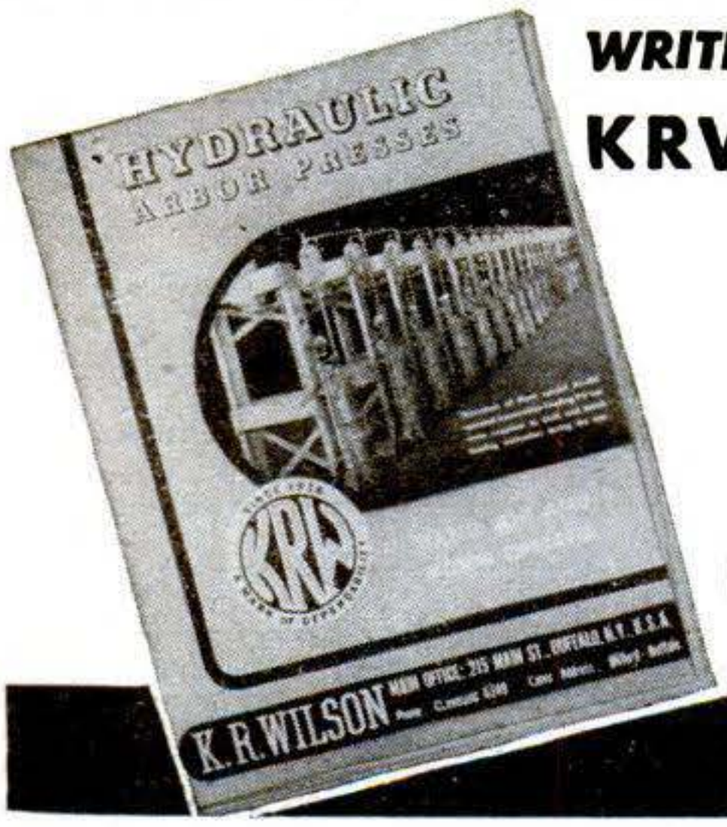

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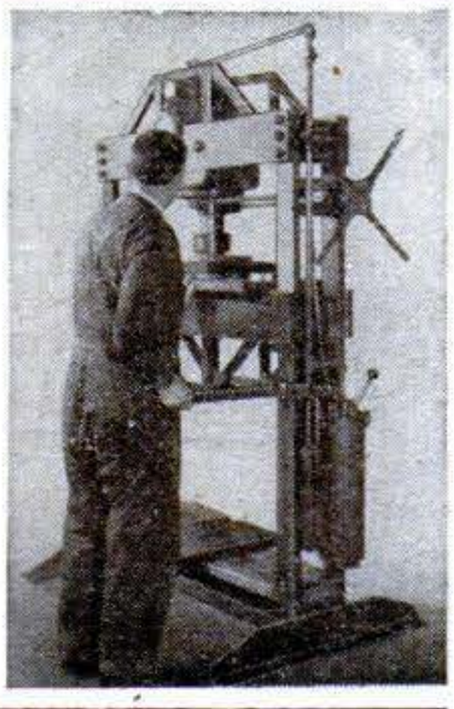
Describes all manner of Production and Shop Work on KRW Hydraulic and Bench Type Arbor Presses. 32 pages illustrating the new KRW Hand-operated, Electric-operated and Air-operated Hydraulic Presses. ***Write for your copy today.***



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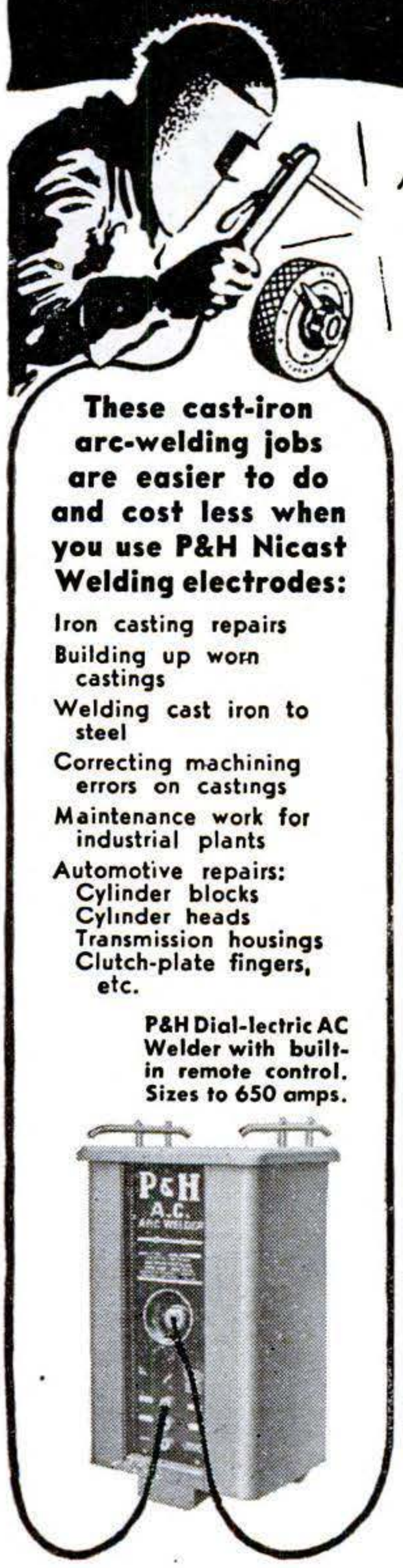
Weld Cast Iron this Easy Way

Use P&H Nicast electrodes — and get sound, fully machinable welds



These cast-iron arc-welding jobs are easier to do and cost less when you use P&H Nicast Welding electrodes:

- Iron casting repairs
- Building up worn castings
- Welding cast iron to steel
- Correcting machining errors on castings
- Maintenance work for industrial plants
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  - Cylinder blocks
  - Cylinder heads
  - Transmission housings
  - Clutch-plate fingers, etc.

P&H Dial-lectric AC Welder with built-in remote control. Sizes to 650 amps.

Nicast is ideal for making quick, easy repairs in cast iron, reclaiming cast-iron parts, and correcting machining errors

Yes, welding cast iron is easy when you use P&H Nicast electrodes. Why? Because Nicast operates in a low heat range — no preheating, no postheating, no other time-consuming preparation is required. And, too, you can weld with Nicast in any position — flat, vertical, overhead, horizontal.

Here's why Nicast welds are easy to machine

The steady, soft arc produced by Nicast has just the right amount of penetration. This feature, with the low amperage required, prevents dilution of carbon from the parent metal to the fusion zone and to the weld metal deposited. This absence of diamond-hard carbon particles is what makes Nicast easier to machine than other electrodes.

There is no hard fusion zone to drill, tap, mill, or machine. Tools and cutters stay sharp longer, break less often. Your work is finished in less time. And you make more profit on every cast-iron repair job you do with Nicast.

Nicast welds are sound

After machining or grinding, Nicast welds almost match the color of the parent metal. But more important, they are non-porous and free from cracks. Prove this to yourself by checking a multiple-pass Nicast weld under hydrostatic pressure.

Nicast can be used on any type of welder

This versatile P&H electrode operates equally well on AC or DC current. You can use it to reduce welding time and save money, no matter what type of welding machine you have.

And speaking of welding machines, we suggest that you get all the facts about the new P&H AC Arc Welder. *This is the only welder with easy-to-use Dial-lectric Control.* It has no moving parts and needs no maintenance.

Connectible to 220-or 440-volt current, the P&H Dial-lectric has many features that help to reduce welding costs. Here are a few that make for better, faster welding: Built-in remote control. Easy quick-start arc. High-low welding range. Elimination of arc blow. A three-quarter turn of radio-like knob for complete welding range. Compact design. Sizes range up to 650 amps.

Go after profitable cast-iron welding jobs. Your nearby P&H distributor can supply you with Nicast electrodes — the electrodes especially designed to do cast-iron work faster and better. Nicast is available in $\frac{3}{16}$, $\frac{5}{32}$, $\frac{1}{8}$, and $\frac{3}{32}$ sizes and comes in handy 10-lb. containers. See your P&H distributor today or mail us the coupon below, clipped to your business letterhead.

P&H

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4674 W. National Ave.
Milwaukee 14, Wisconsin

HARNISCHFEGER CORPORATION

Manufacturers of America's Most Complete Arc Welding Service

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☐ Send representative ☐ Send address of distributor
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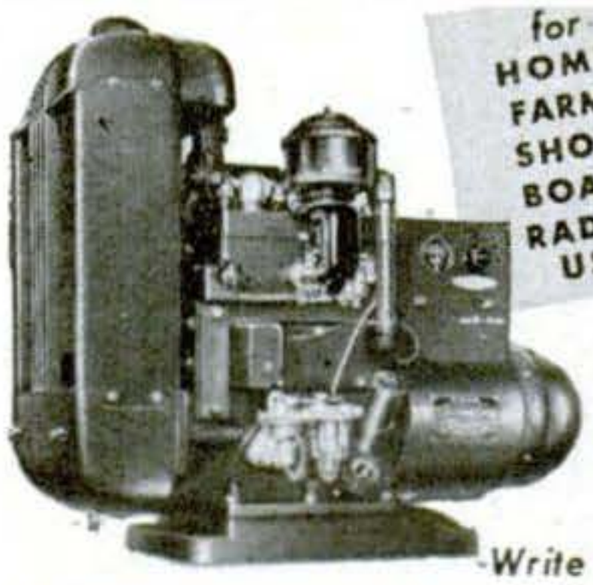

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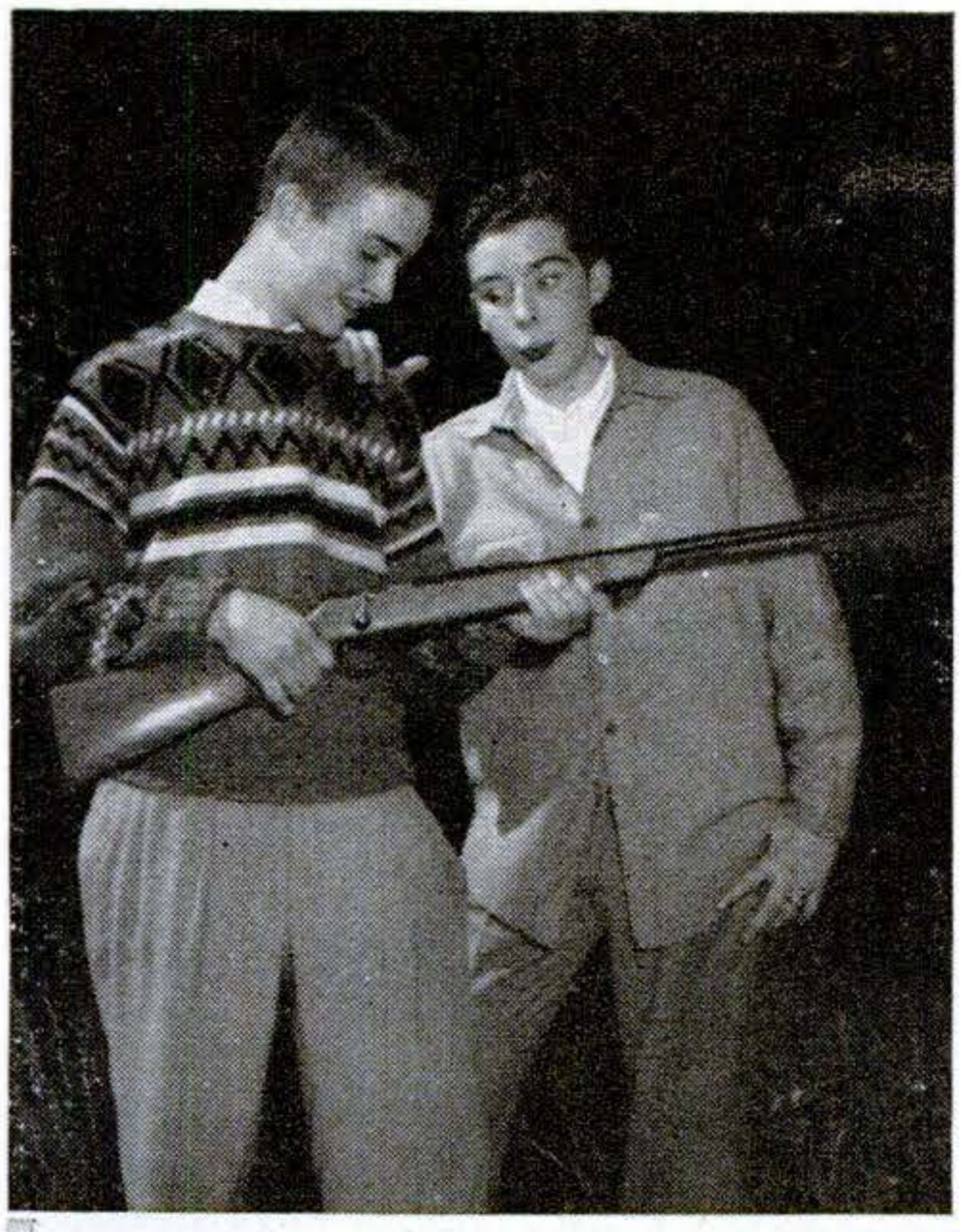

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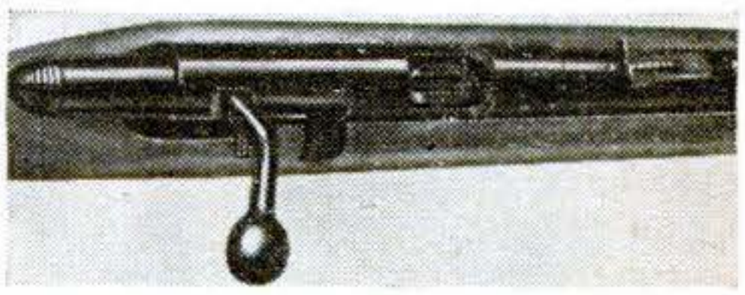

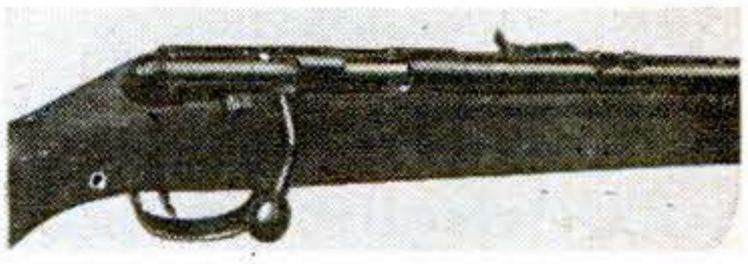

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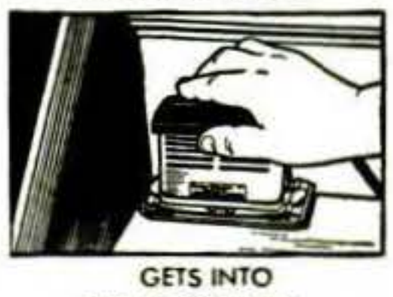
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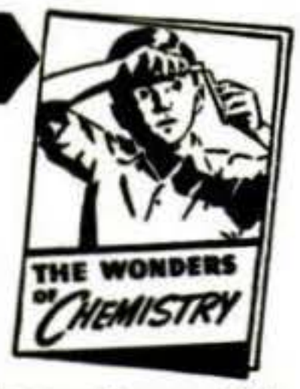

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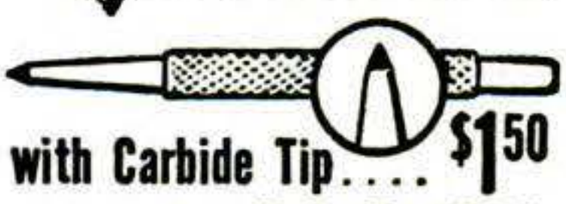

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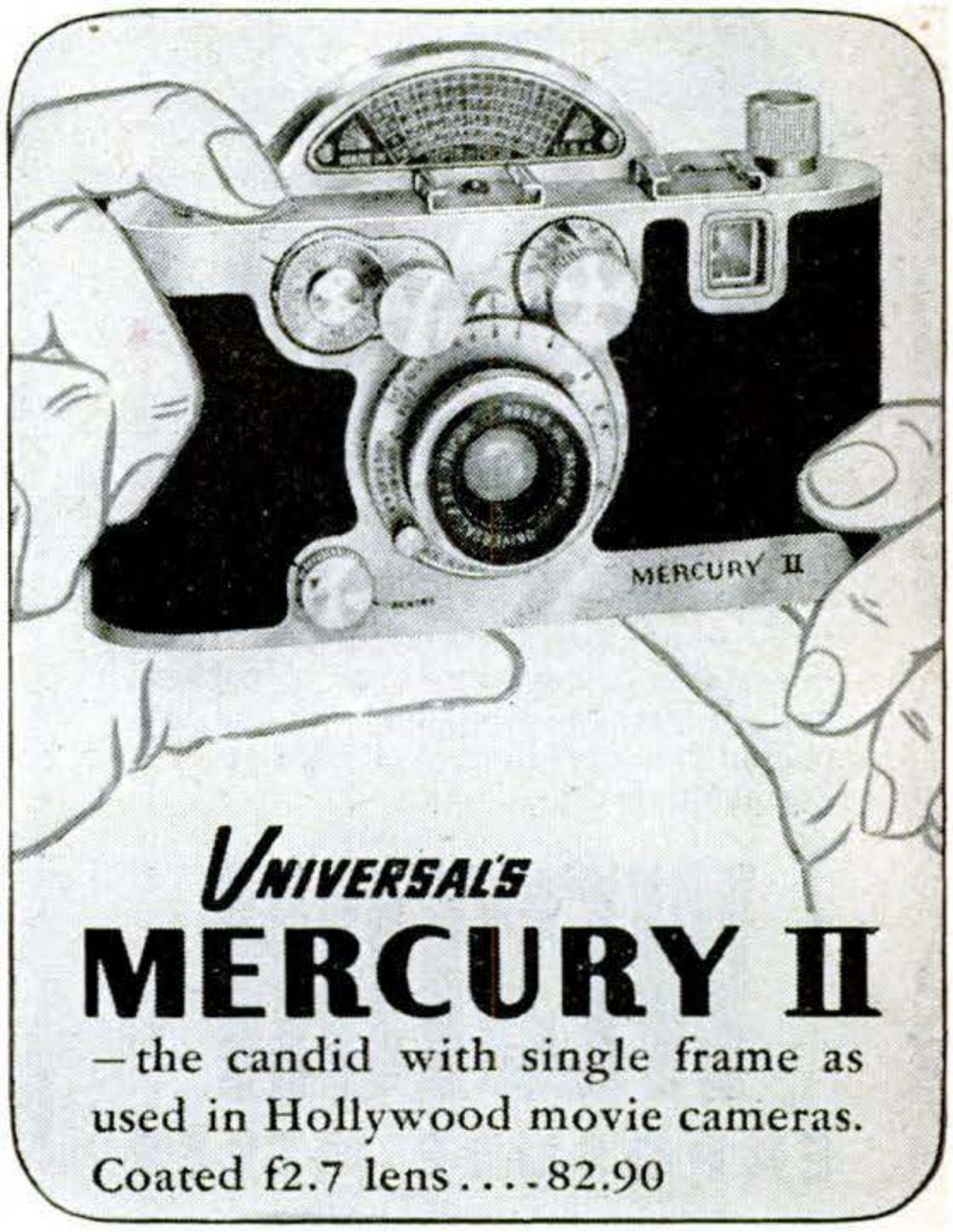

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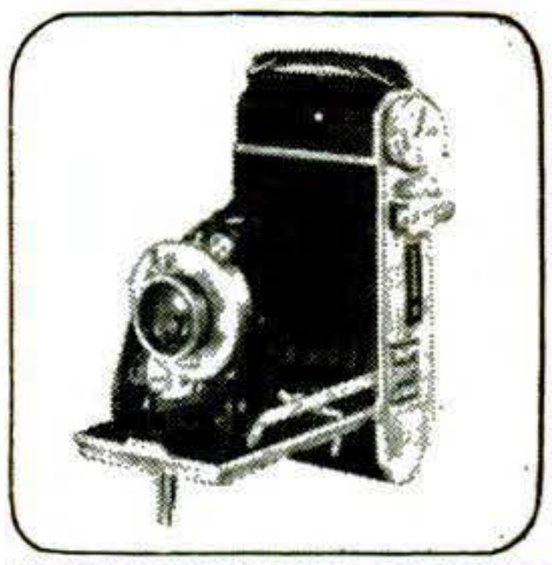

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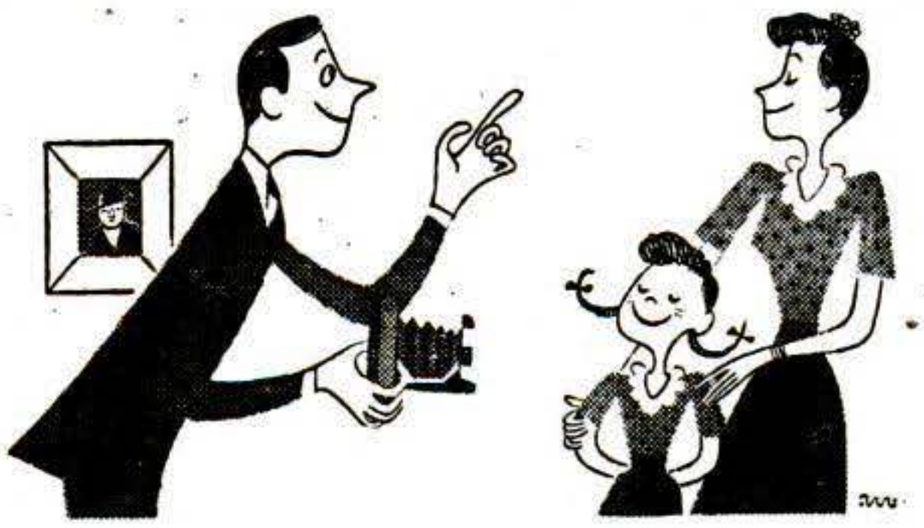

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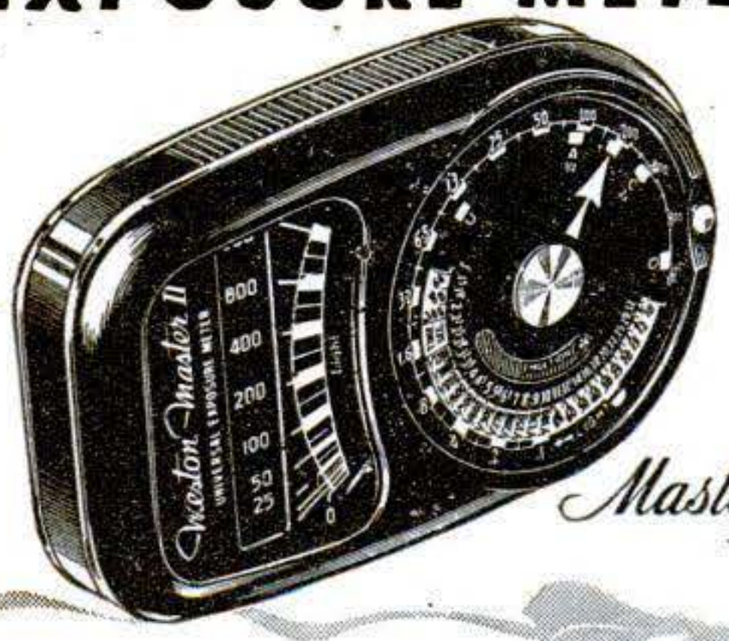

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FOR LATHES

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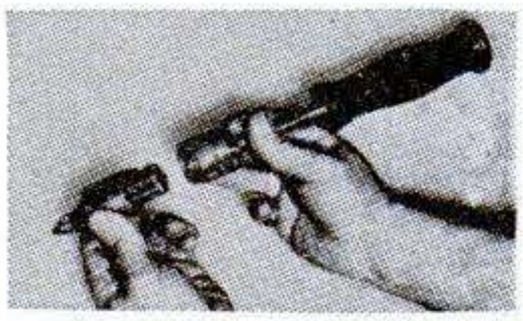

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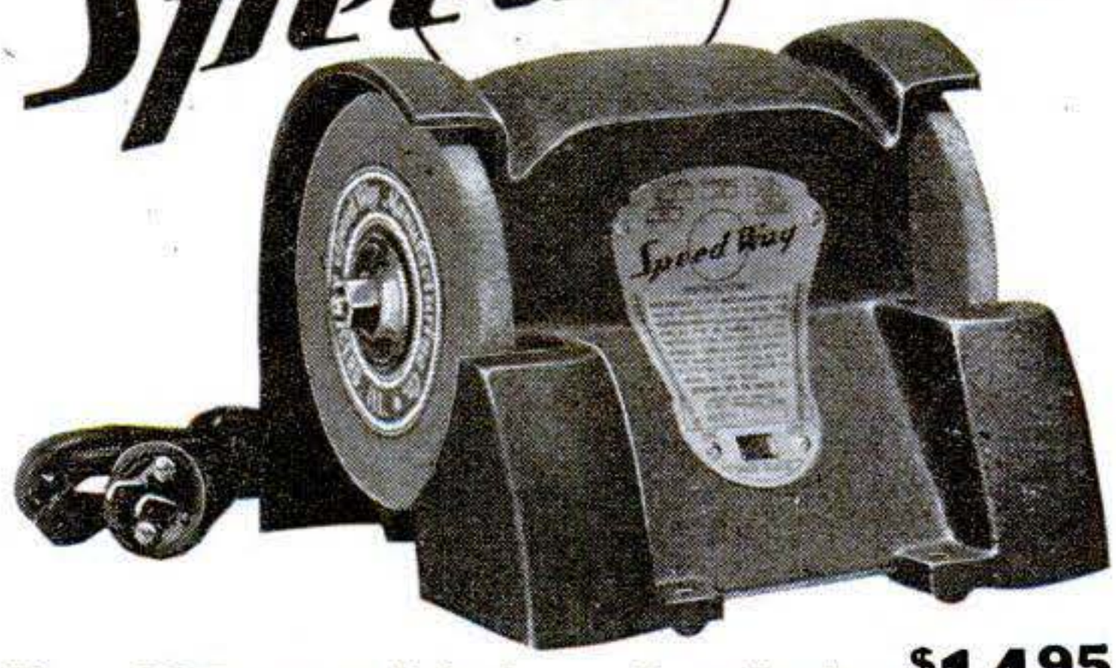

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(B) (C) each	Action Division	Feature Division
1st	$350.00	$350.00
2nd	200.00	200.00
3rd	100.00	100.00

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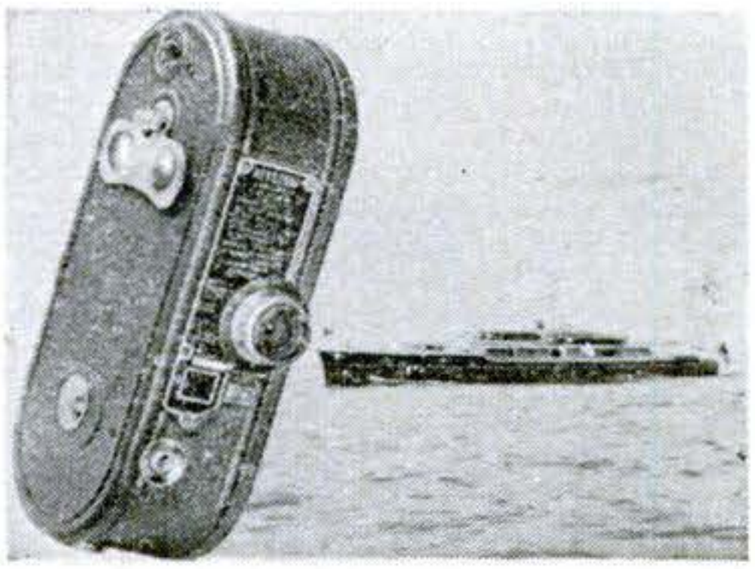

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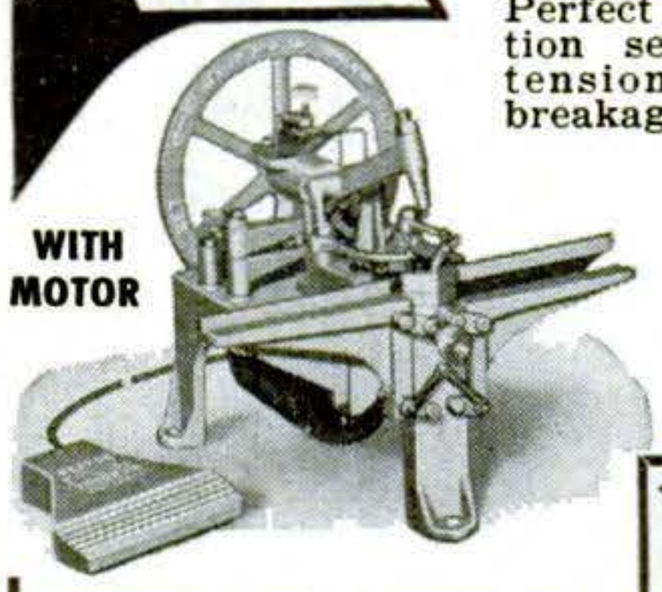

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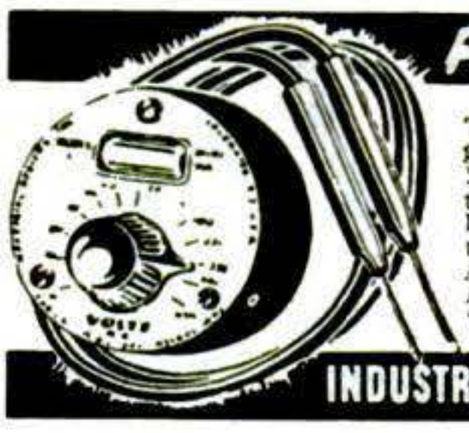

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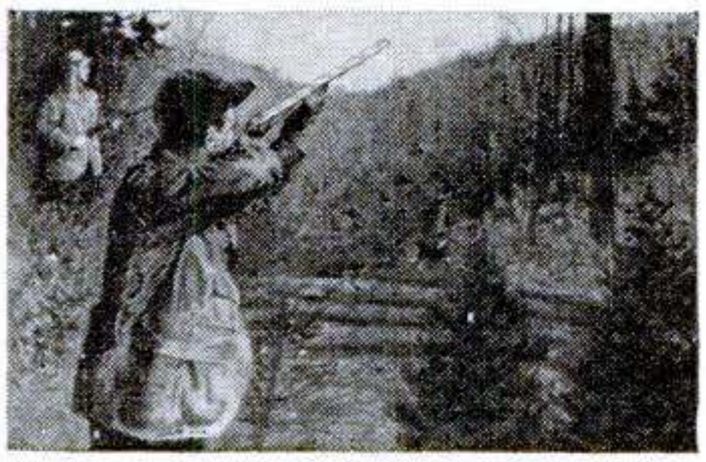

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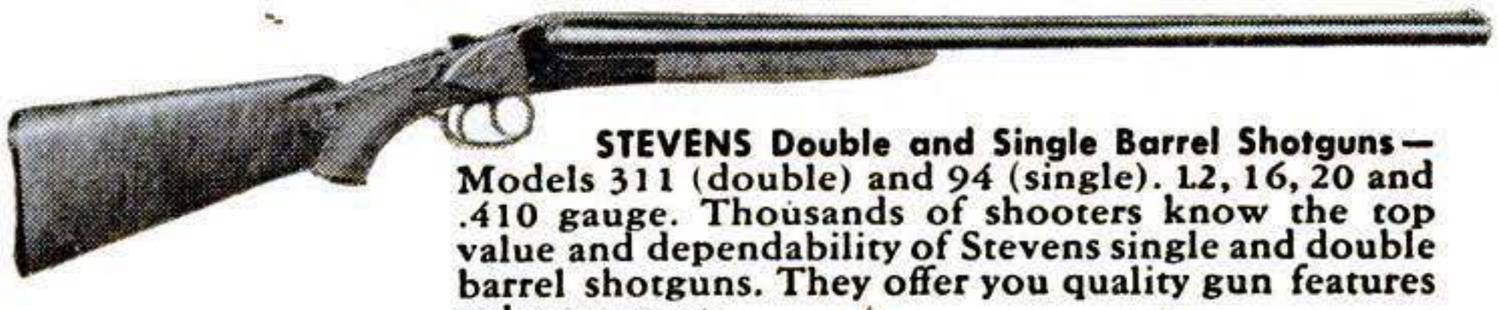

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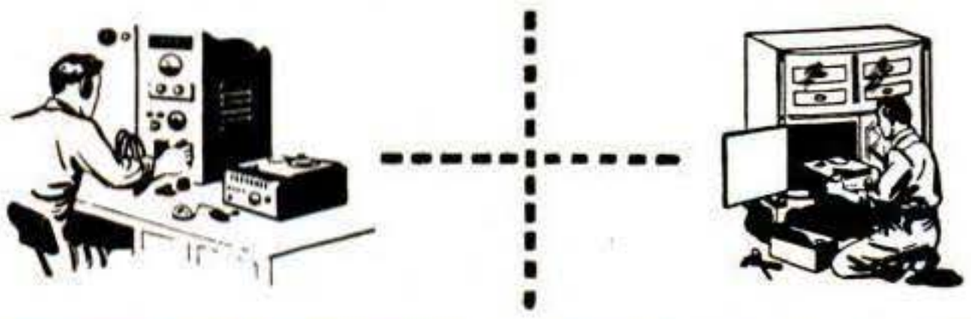

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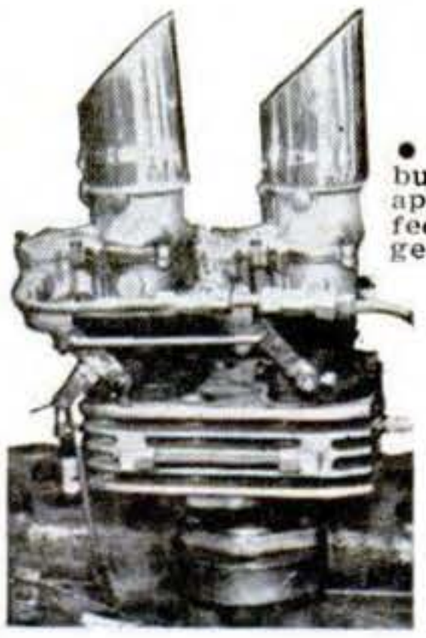

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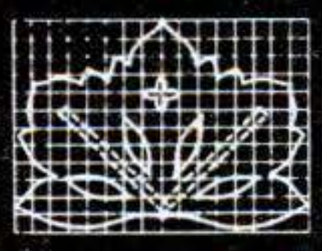

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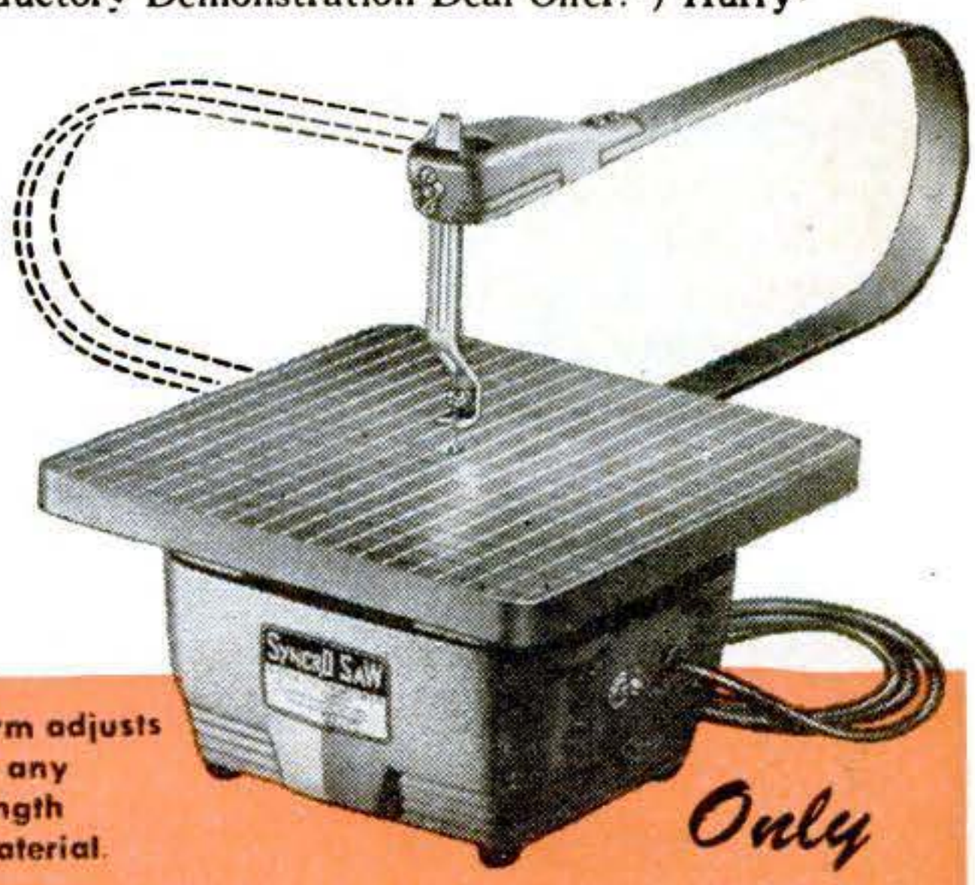

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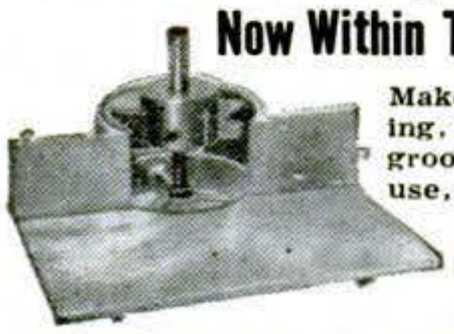

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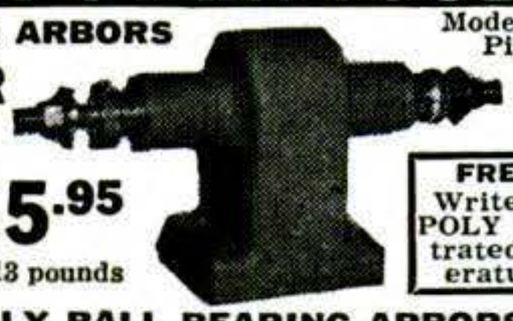

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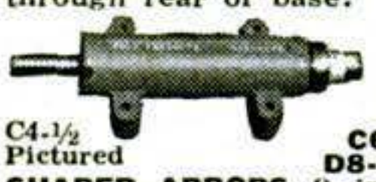

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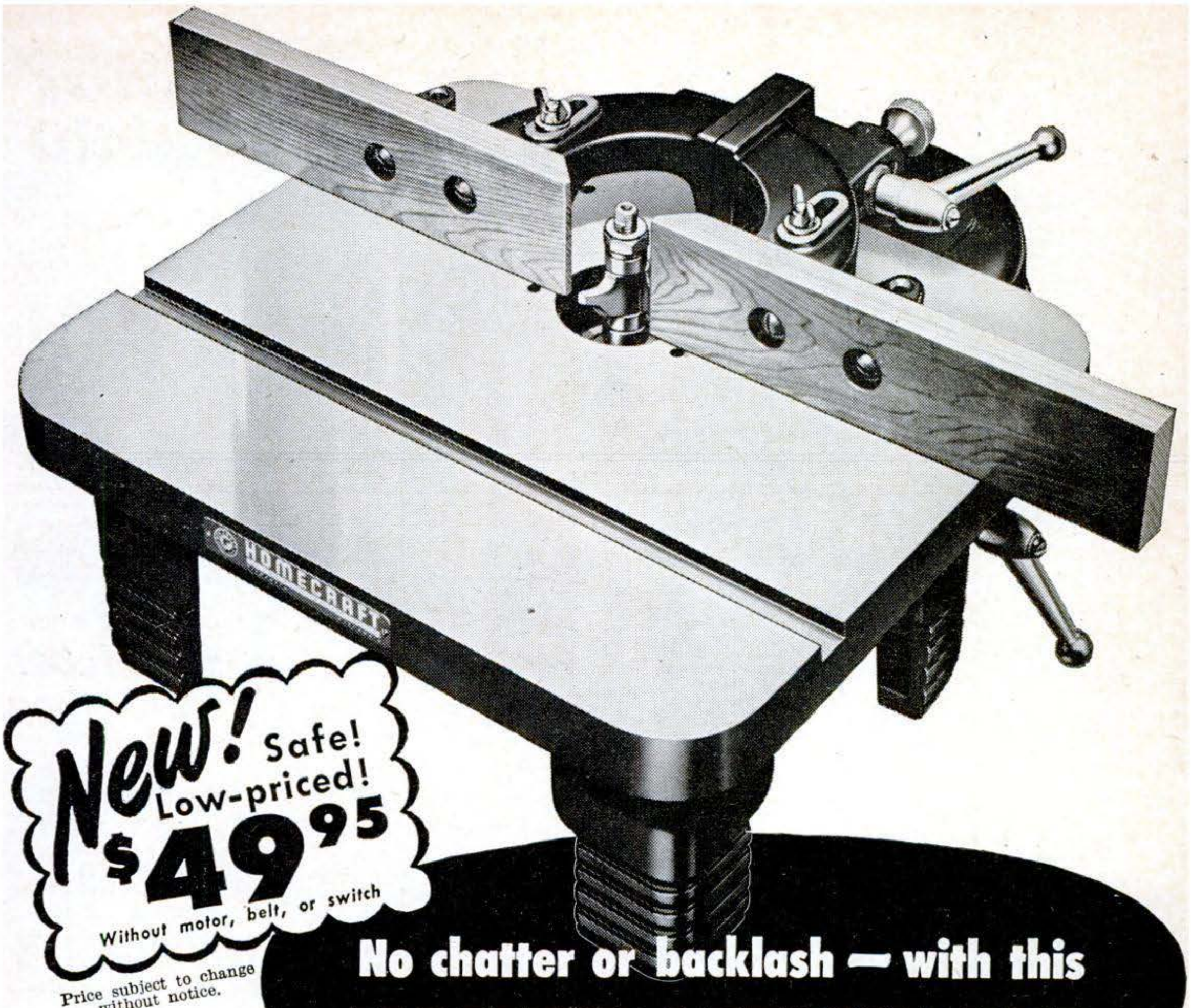

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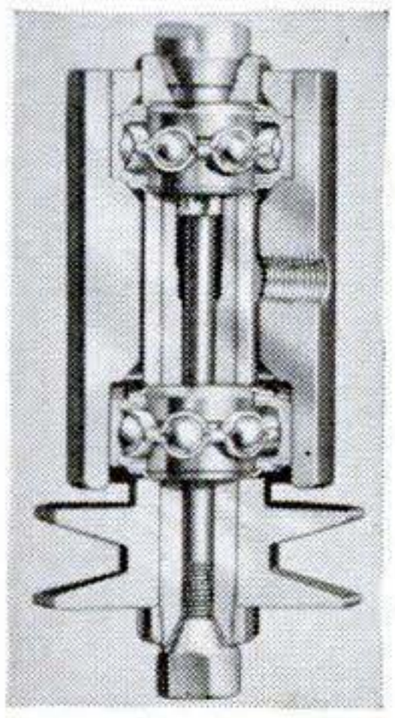

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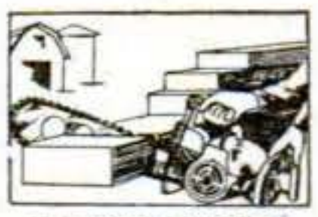
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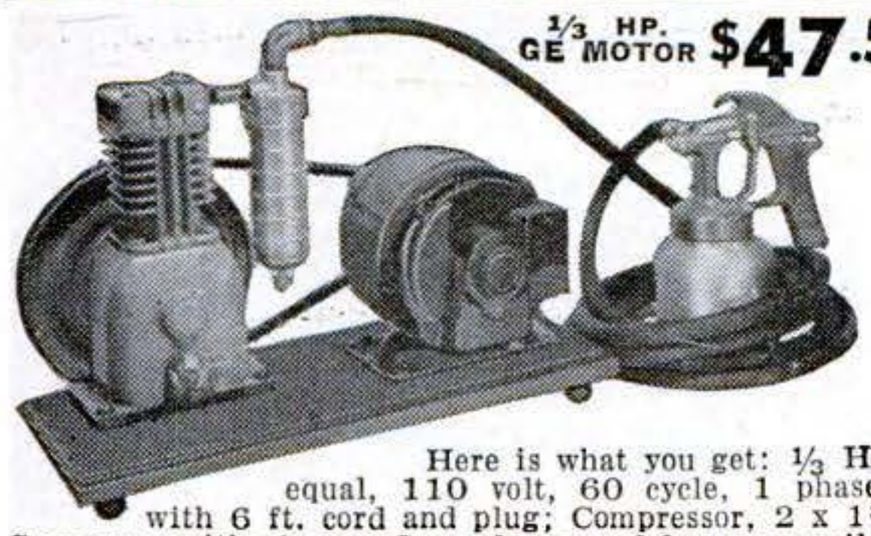

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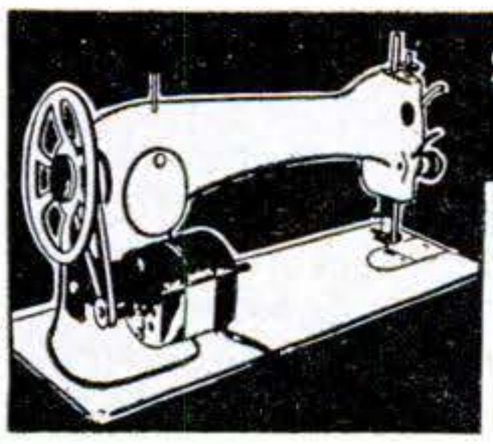

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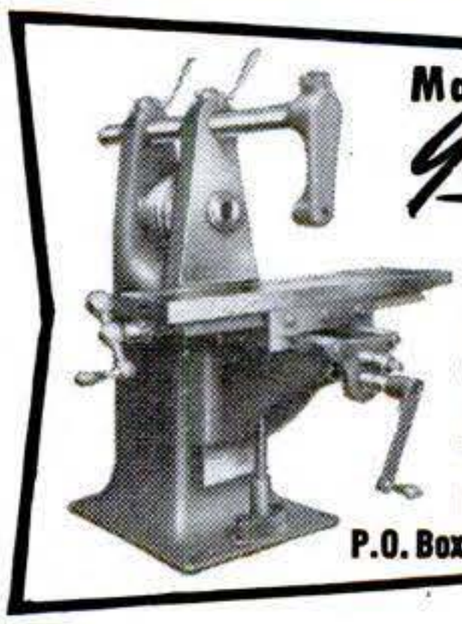

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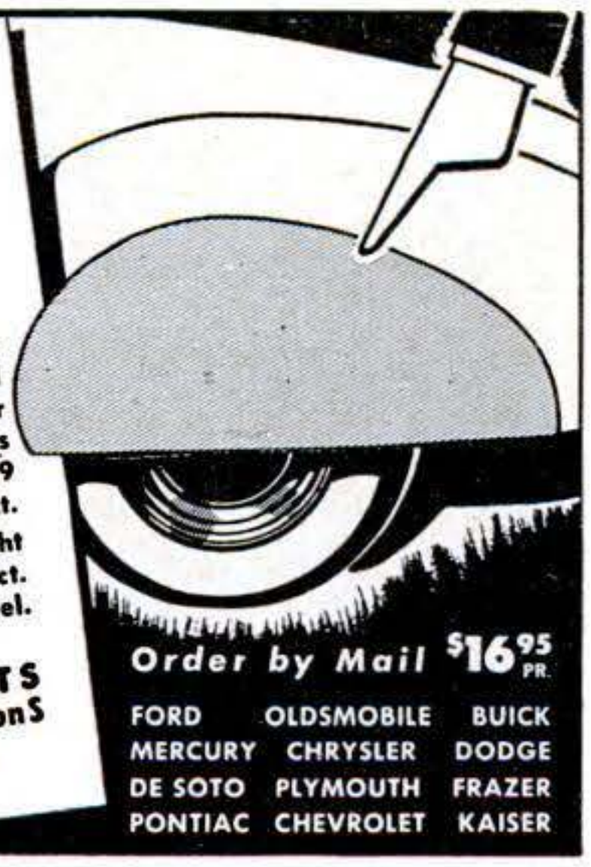

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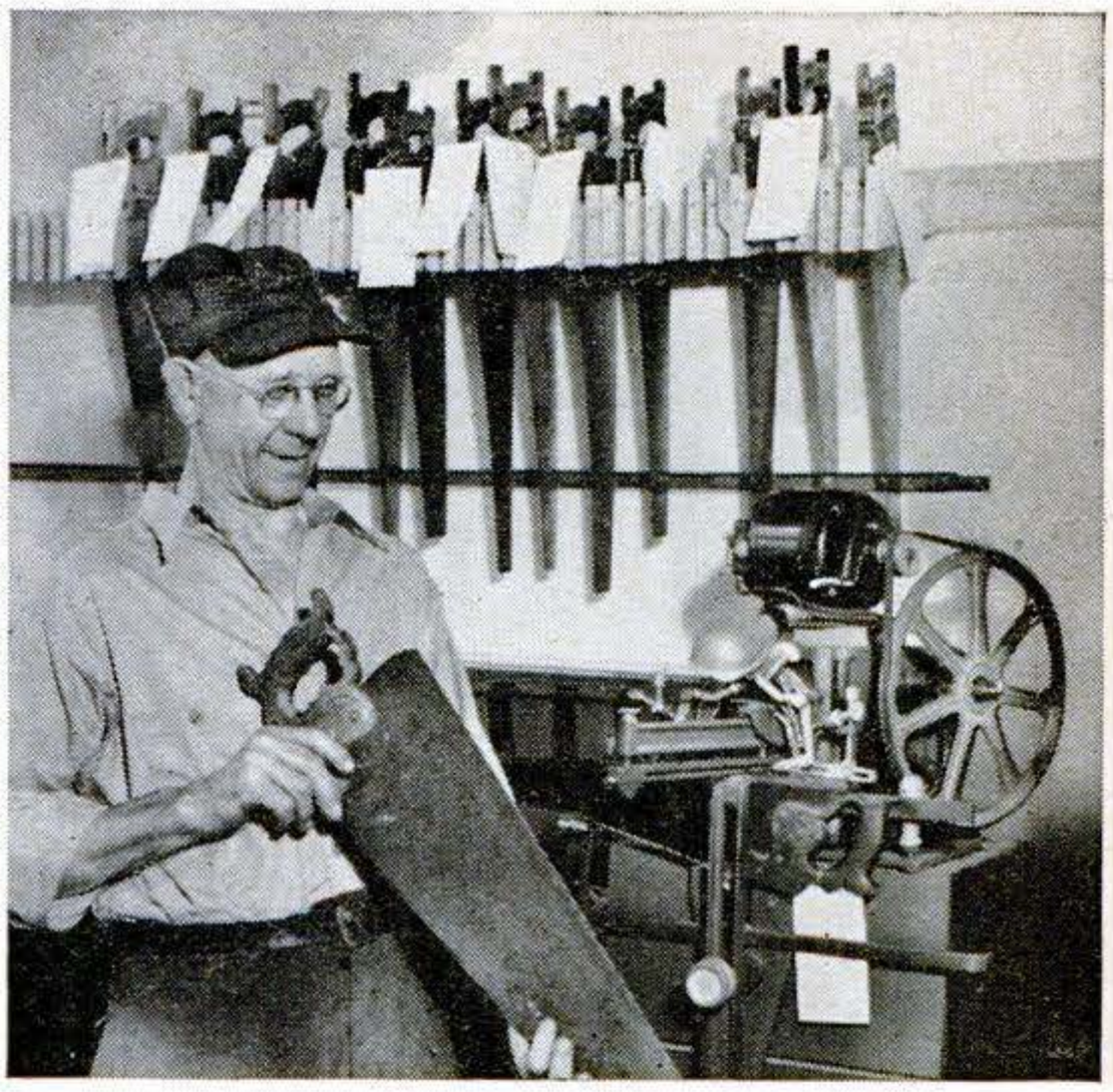

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2	.855	13/16	20	.8595	3-5/16	1.095	15
5	1.250	3/4	20	1.2495	3-9/32	1.452	10
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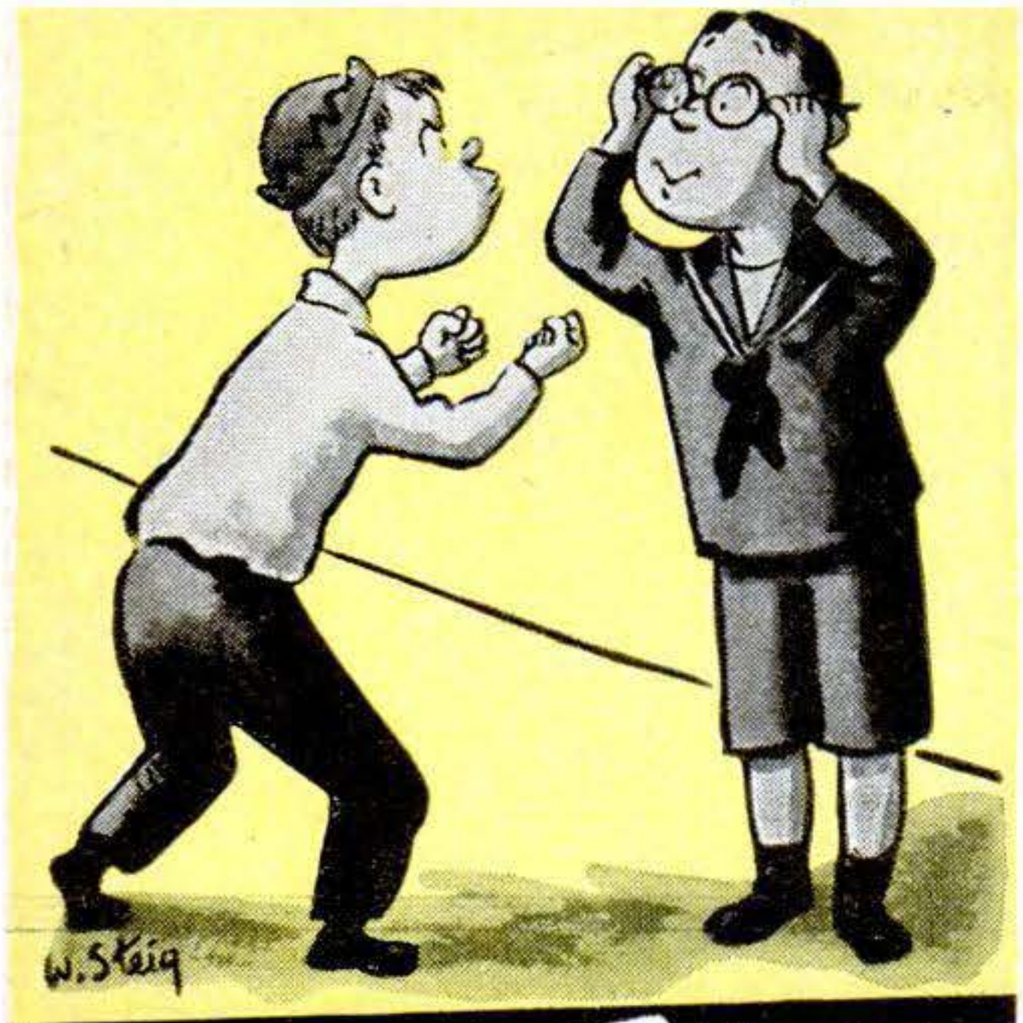

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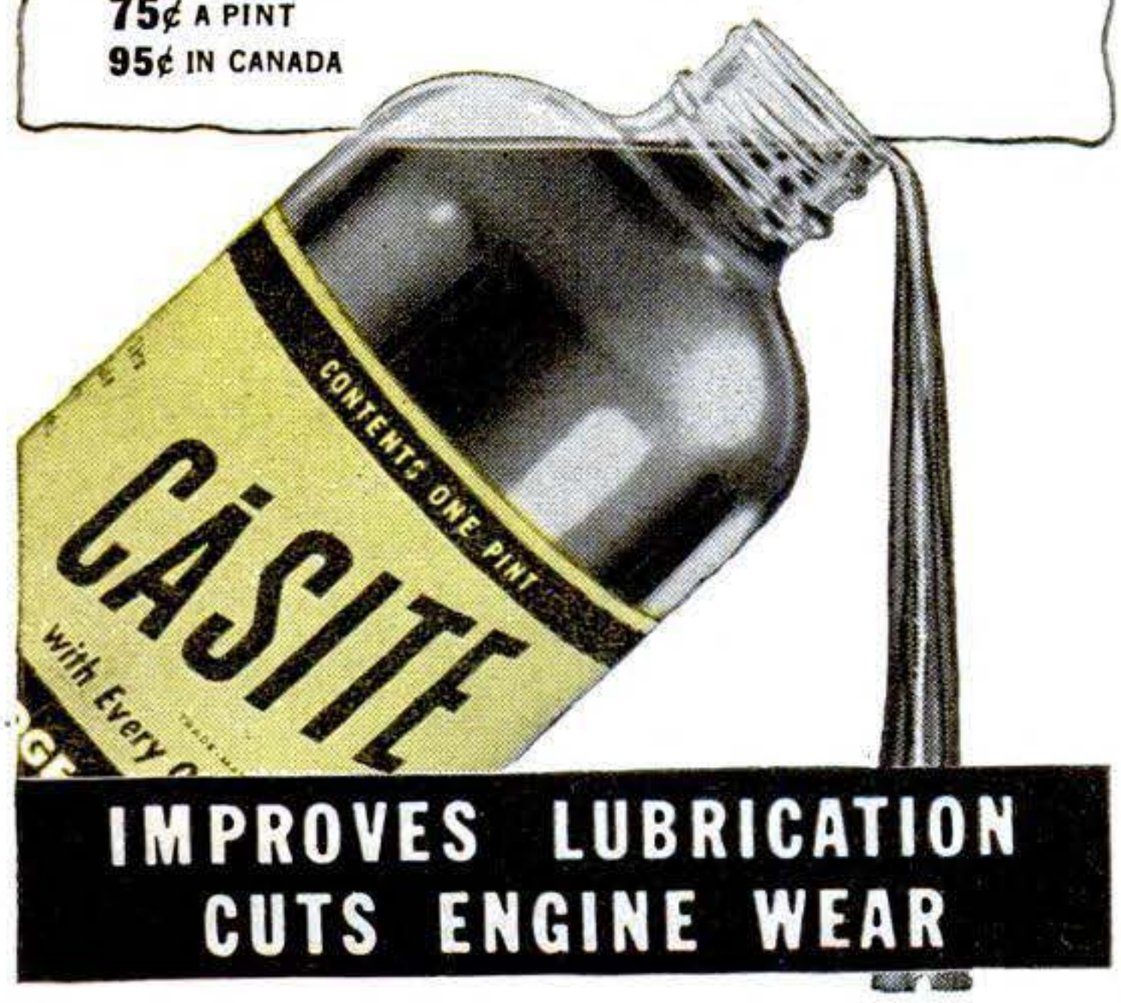

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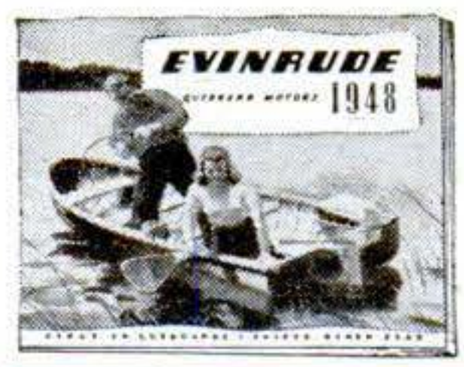

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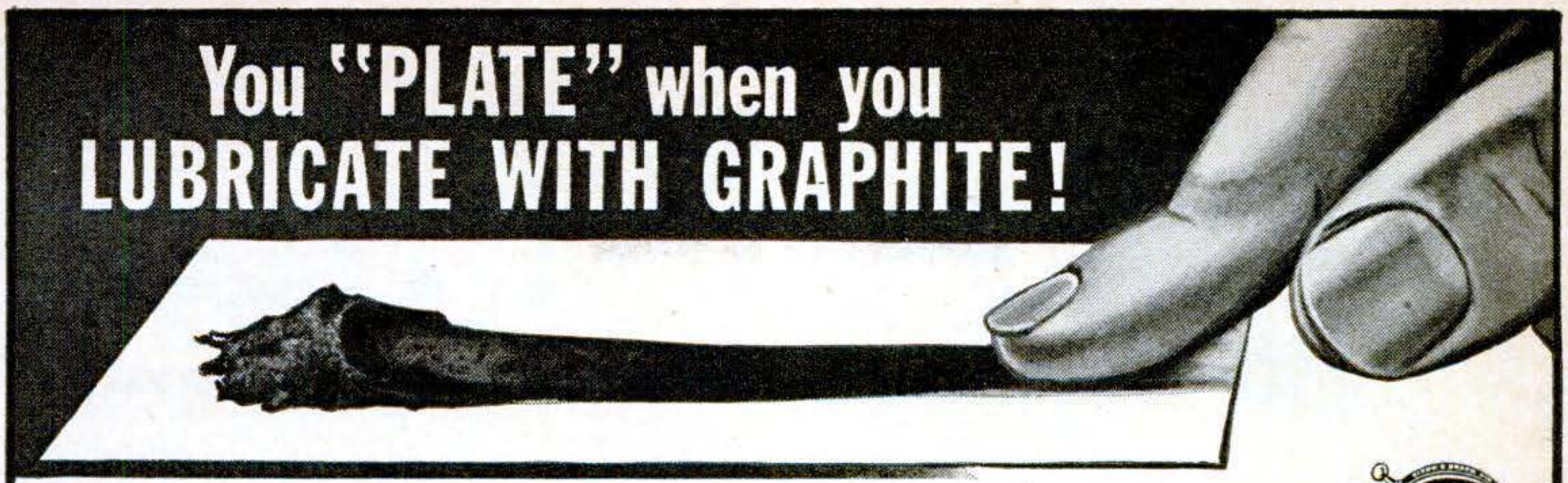

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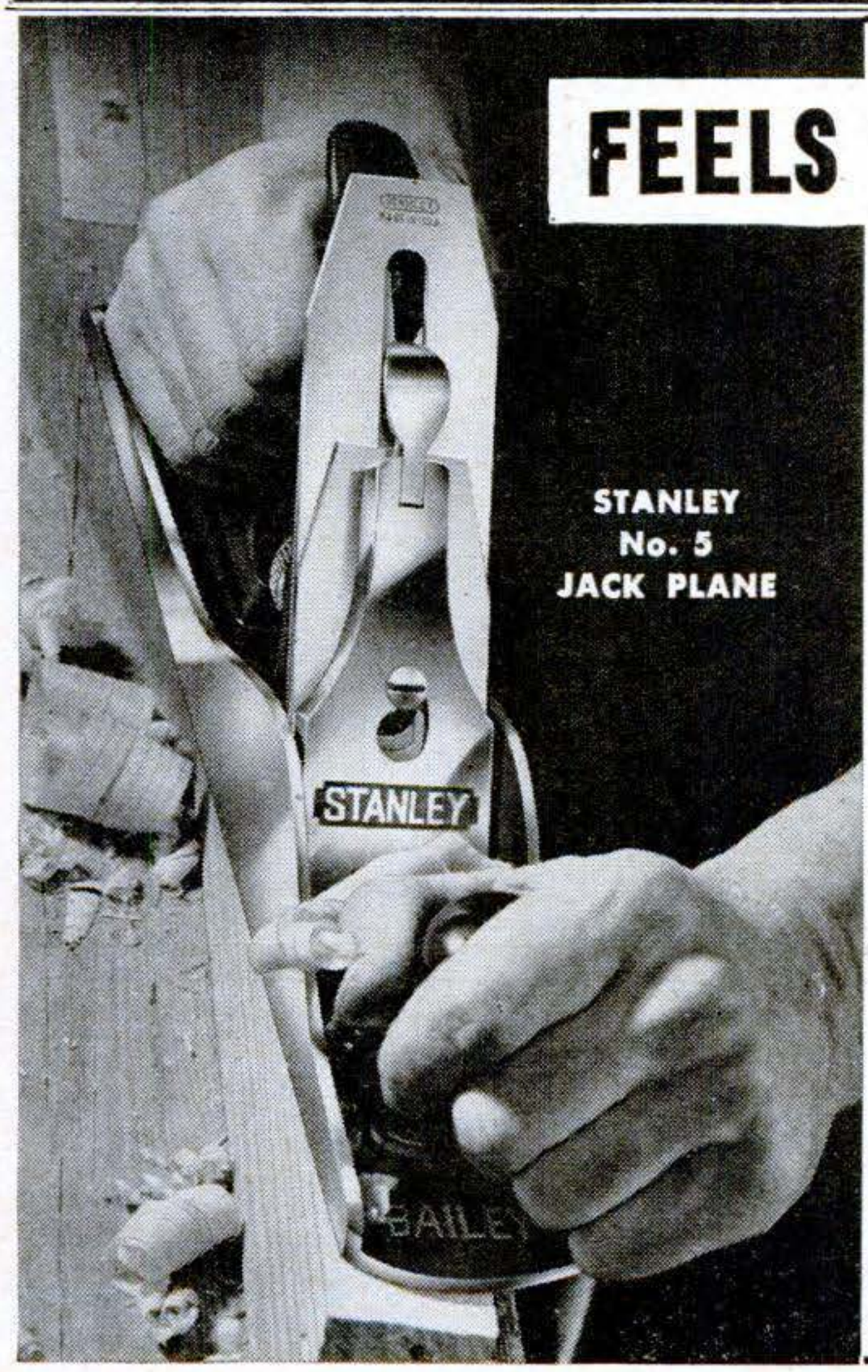

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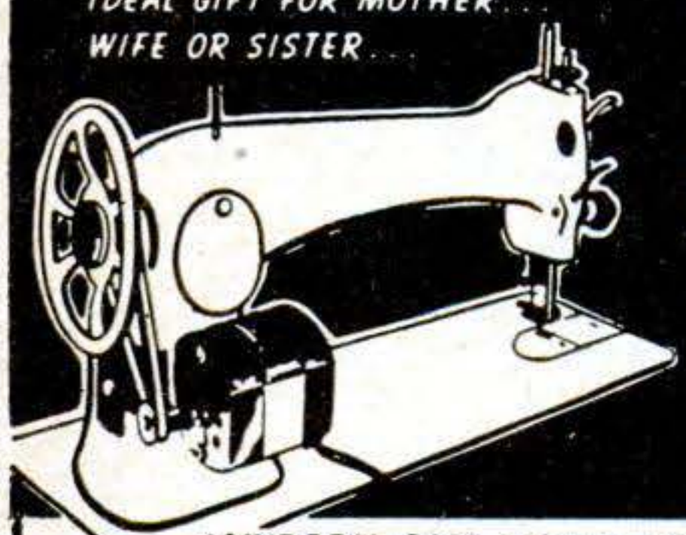

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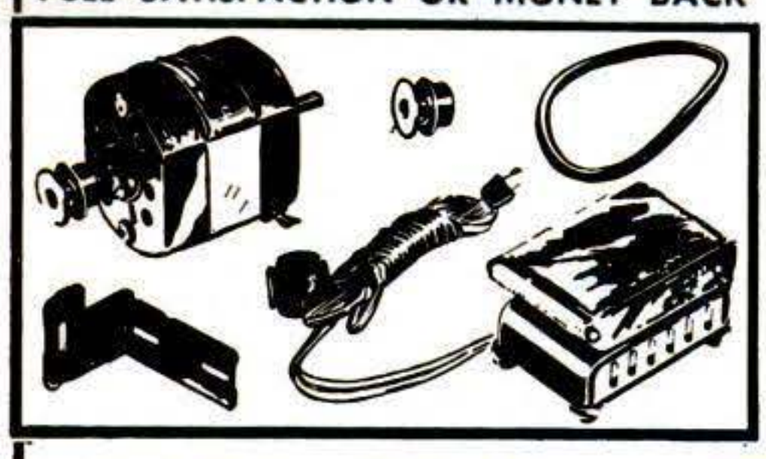

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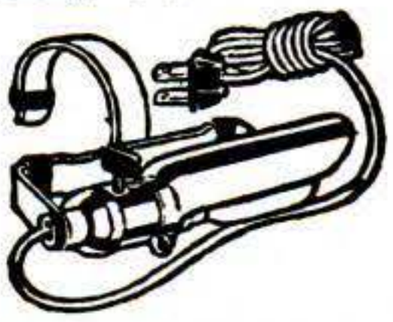

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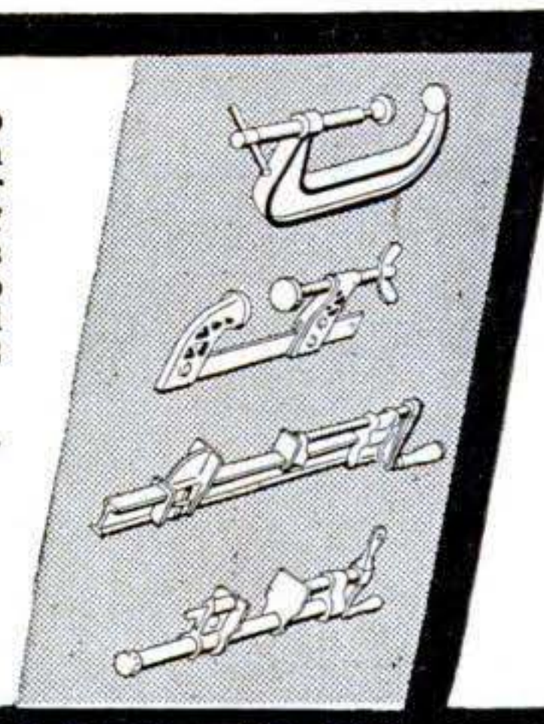

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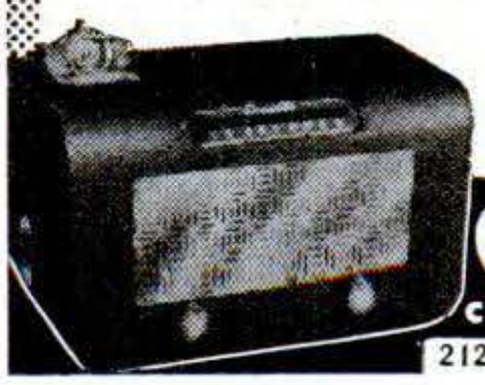

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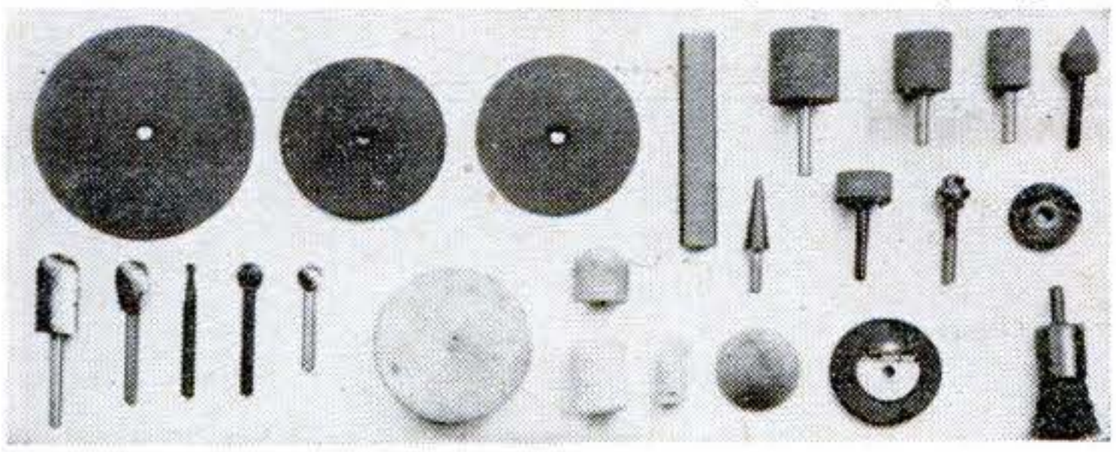

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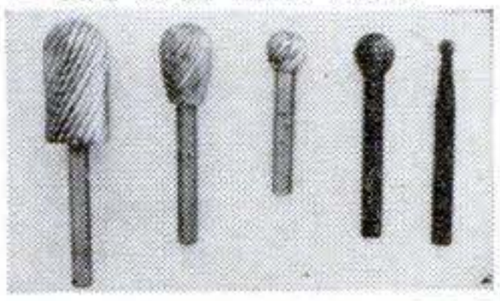

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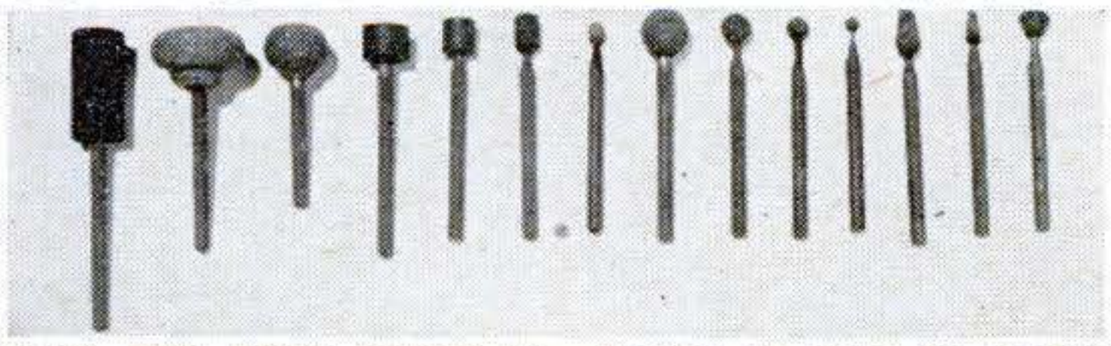

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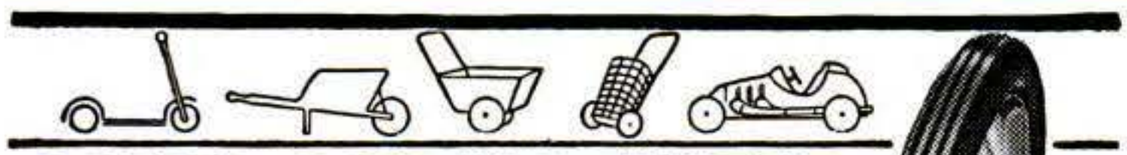

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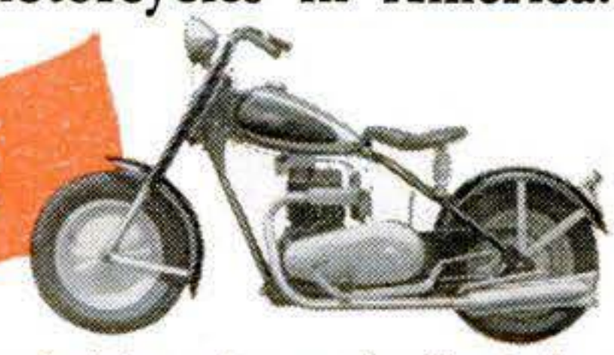

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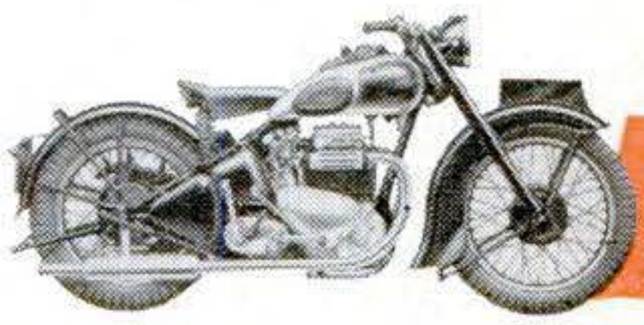

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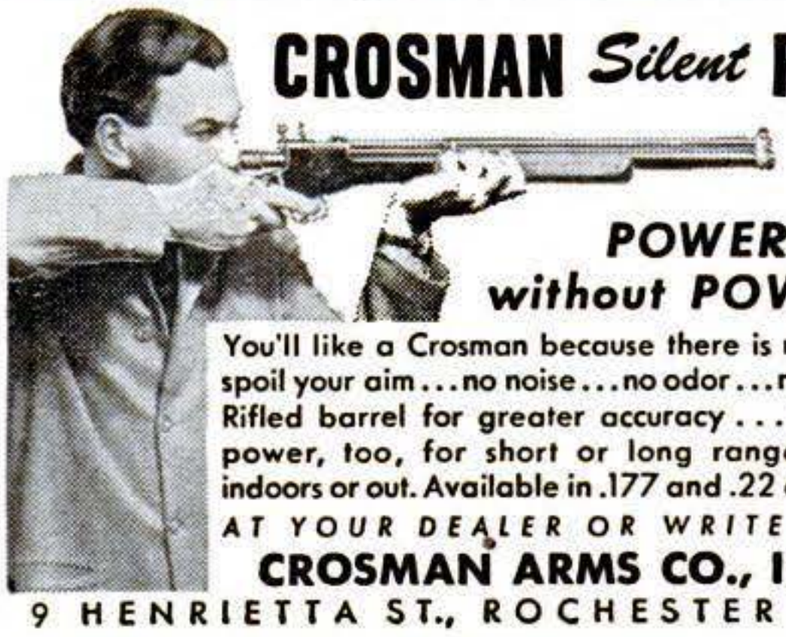

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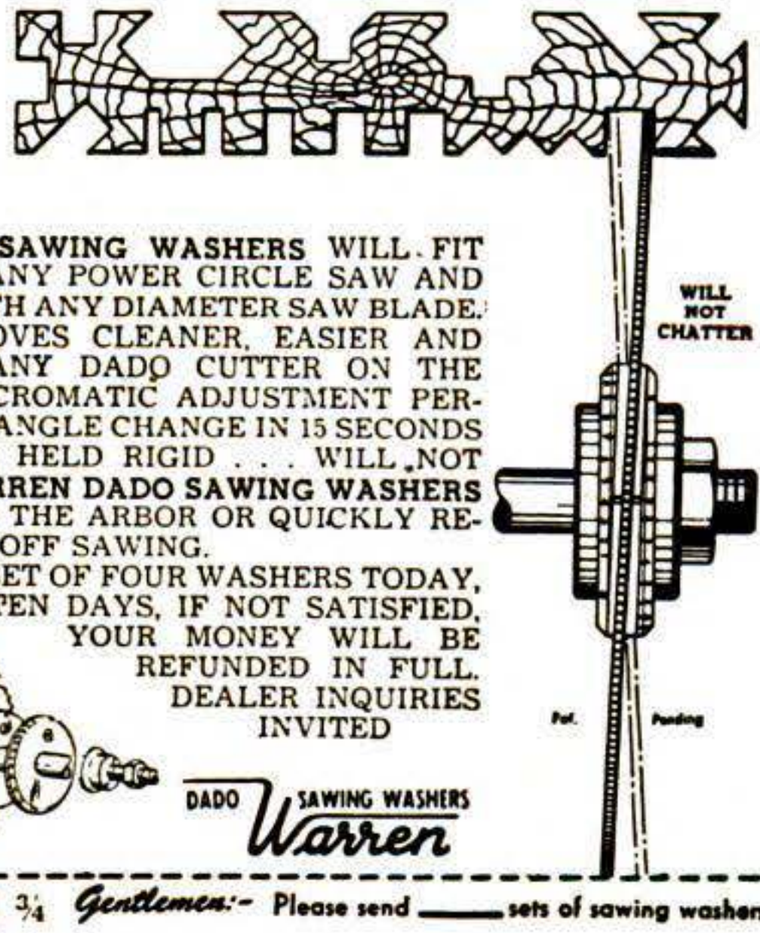

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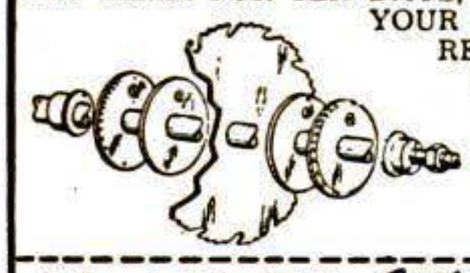

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Gentlemen:- Please send ____ sets of sawing washers:
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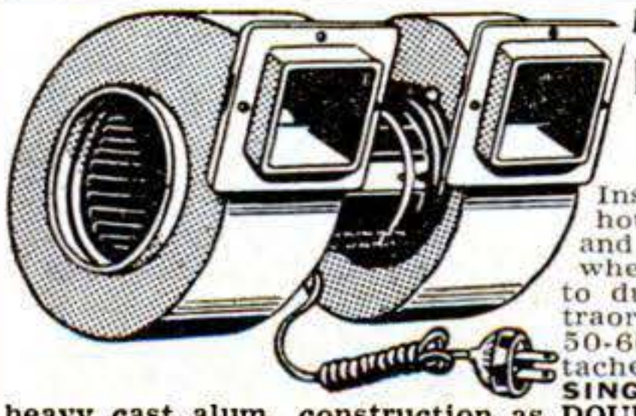

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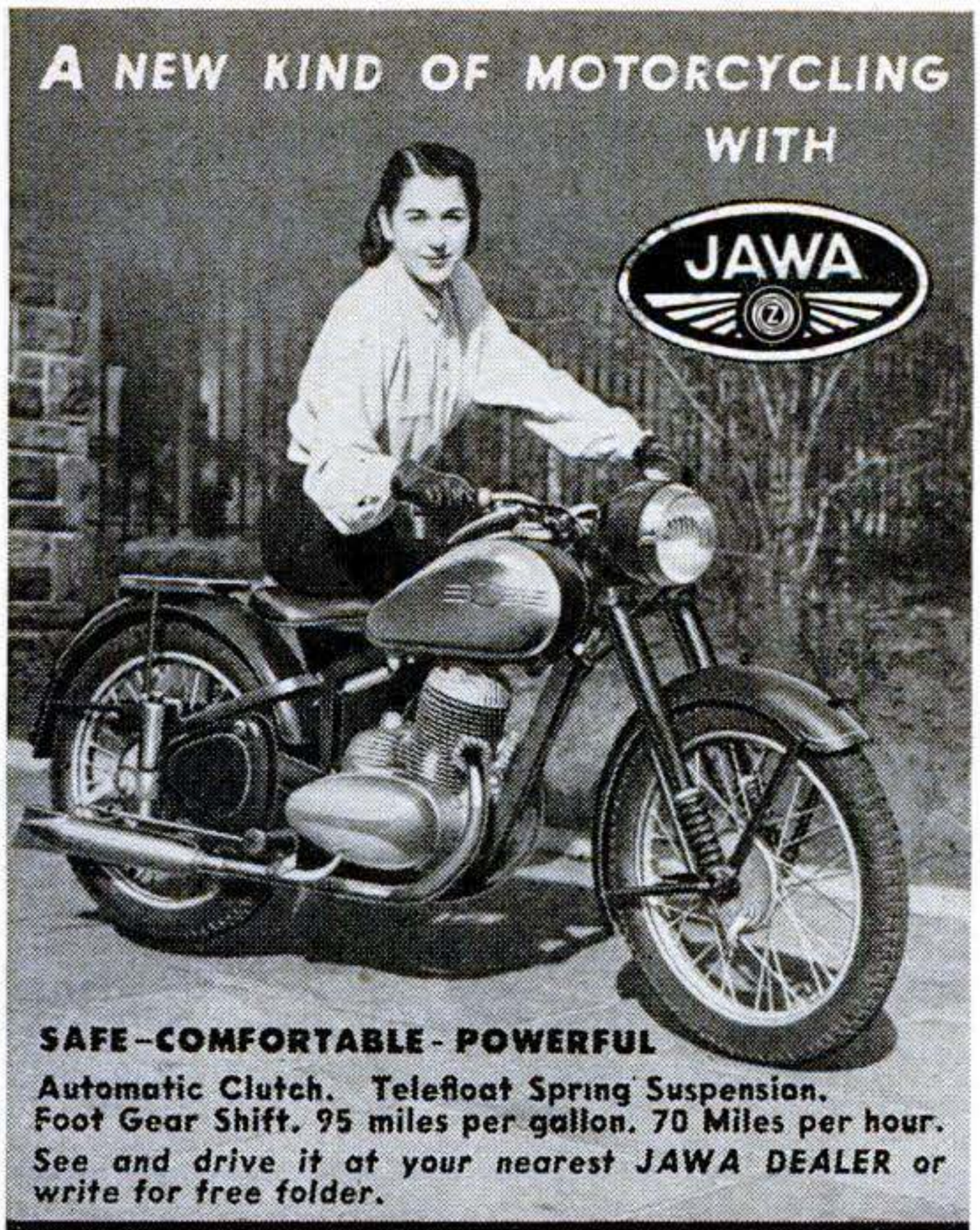

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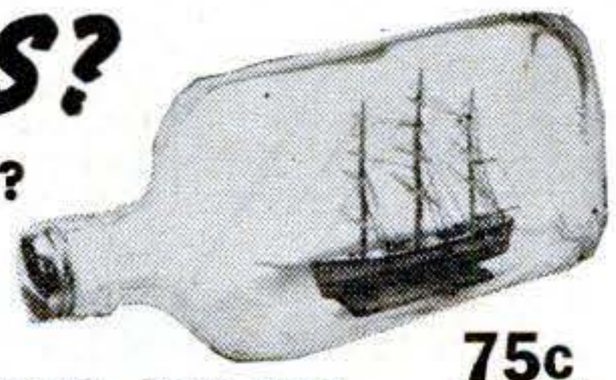

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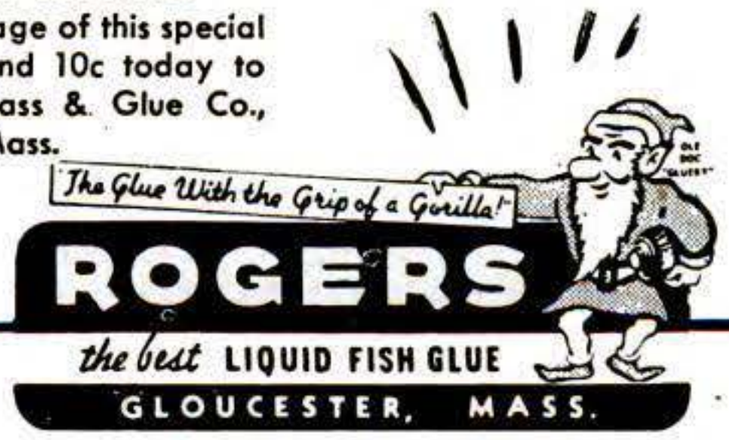

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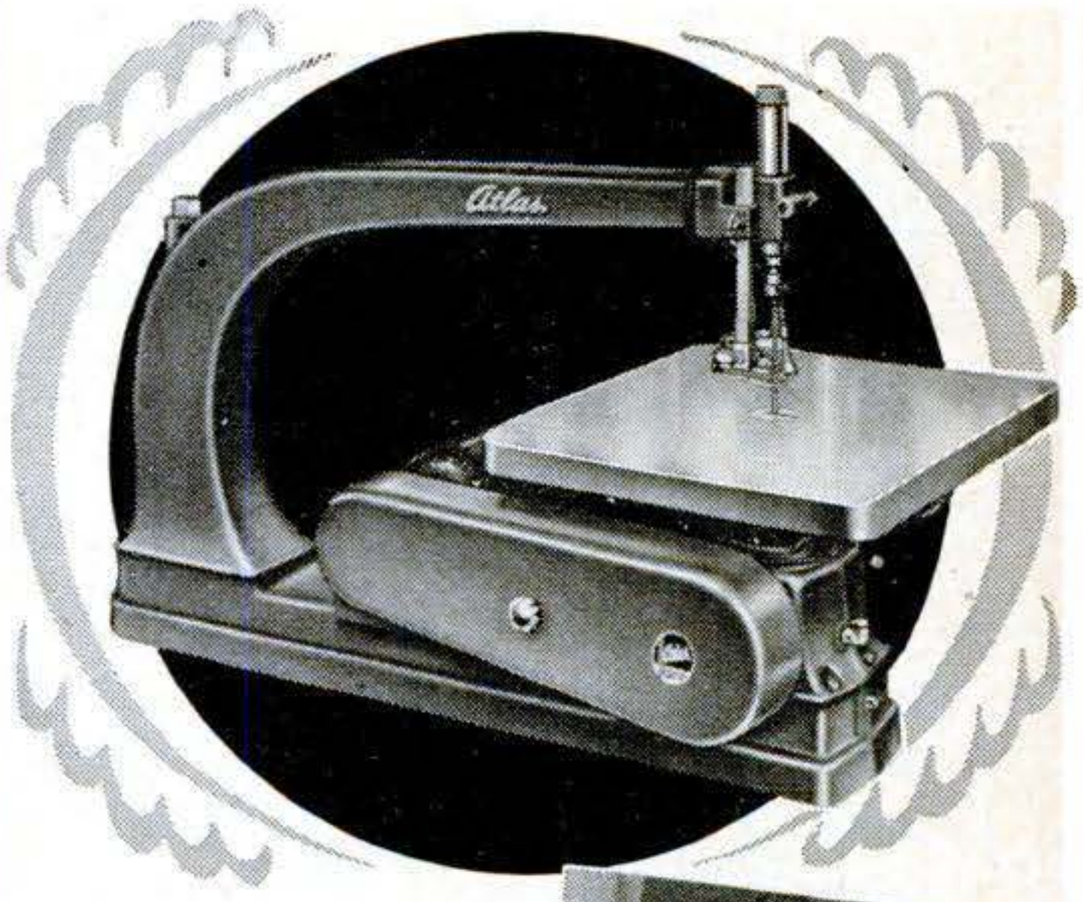
NEW *Atlas* 24" JIG SAW



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This is the jig saw many of America's real craftsmen have long been waiting for. It's big enough to handle any practical jig-sawing project you want to tackle . . . precisely built for professional workmanship . . . just what you need if you plan to make your shop pay you a profit.

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$35.00

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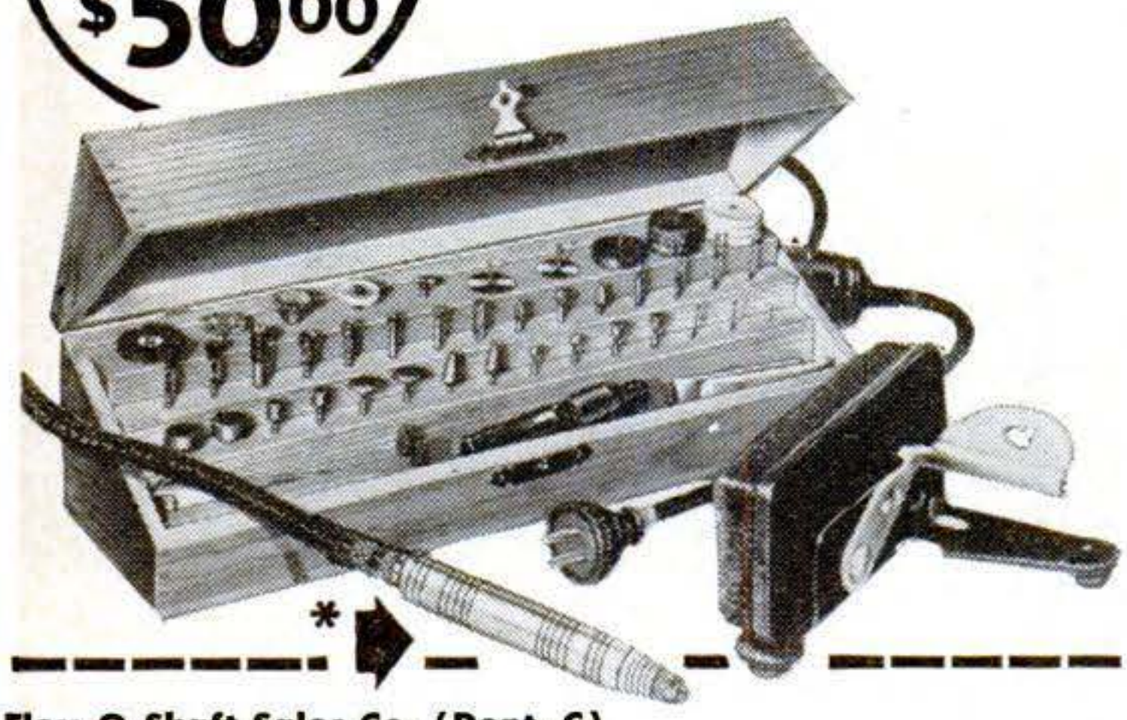

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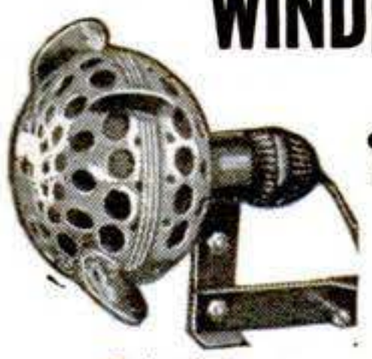

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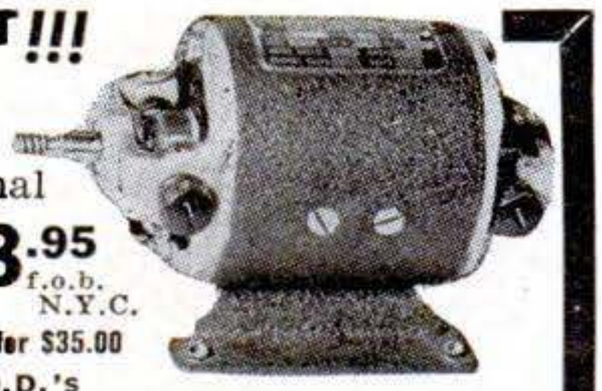

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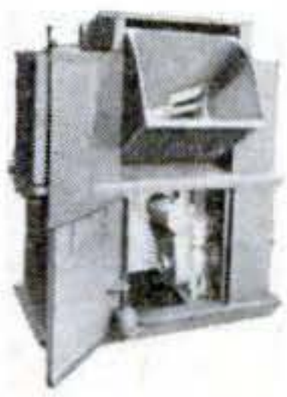
FREE **10 gal. all steel gas tank—with each order. Write for circular—state size or output required.**



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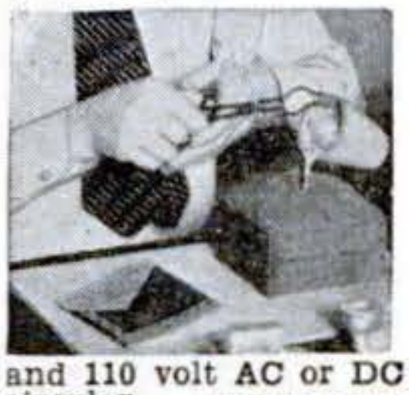

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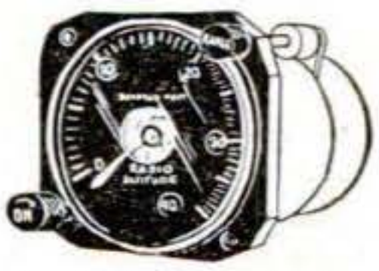

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Complete With Power Unit, 5 Accessories. Sturdy Case and Full Instructions

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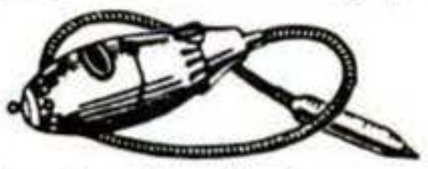
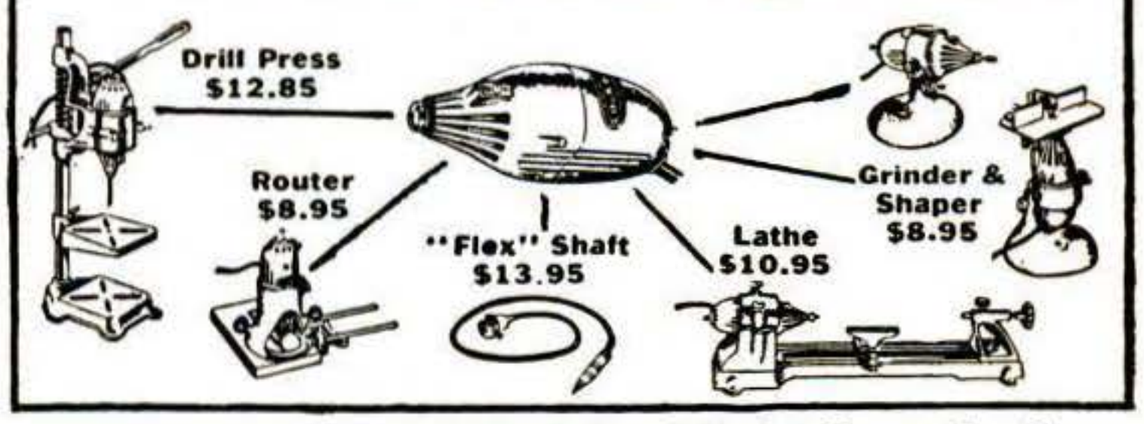


FLEXIBLE SHAFT MEANS ADDED UTILITY!

New DURO flexible shaft with ball bearing hand piece makes engraving, free hand carving, sanding, easier, lots more fun. Double the utility of your DURO Super Power Tool Kit with this useful flexible shaft for only **$13.95**

You can start with this LOW COST Power Tool Kit . . . and BUILD A COMPLETE HOME WORKSHOP

One DURO super power unit is used on all of these home workshop tools! You may buy them singly—or in a group.



WRITE FOR FREE CIRCULAR giving full details on the *Super Power Tool Kit* and the new, low cost home workshop units.

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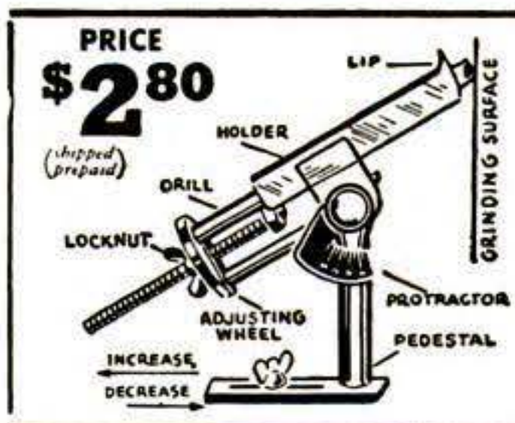

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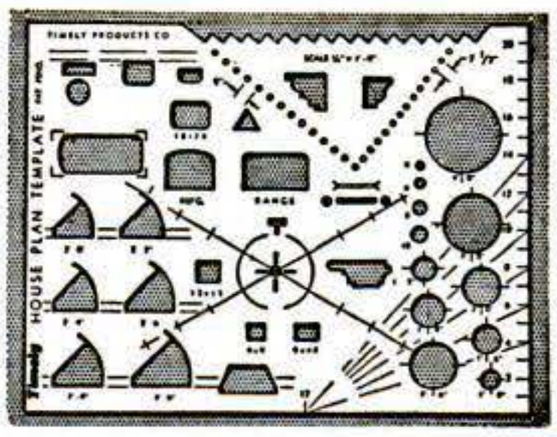

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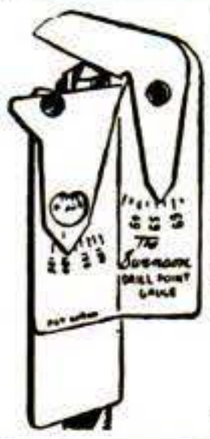

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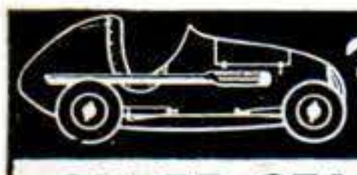

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Lower the body with our special shackles. Easily installed. Gives car that fast, low racing look. Set of 4—**$1.50**
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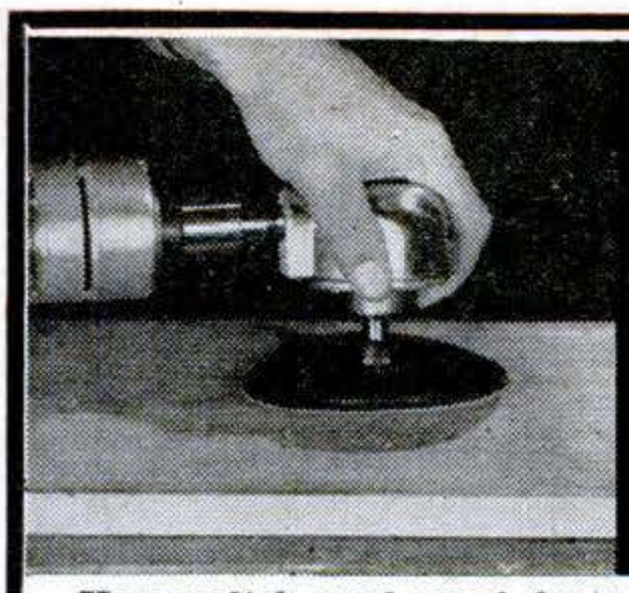
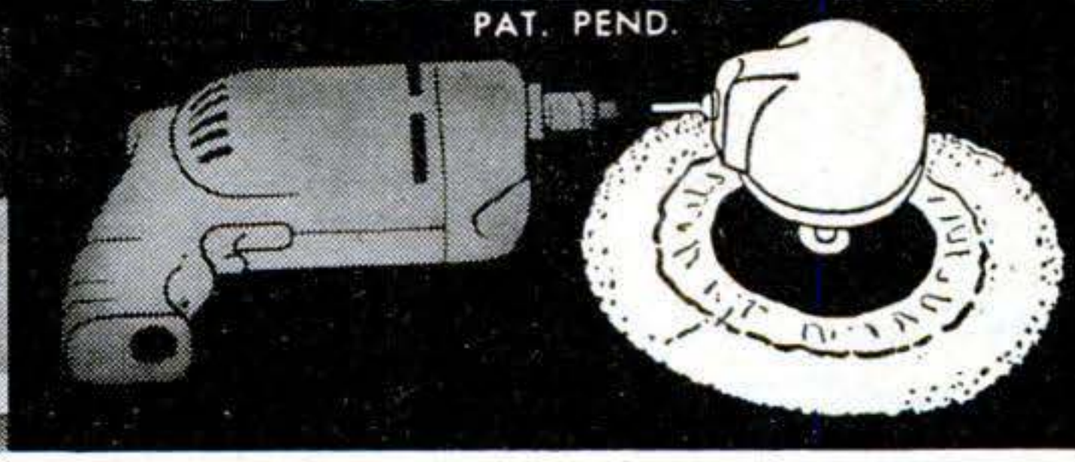


THE BULL BUFFER

PAT. PEND.

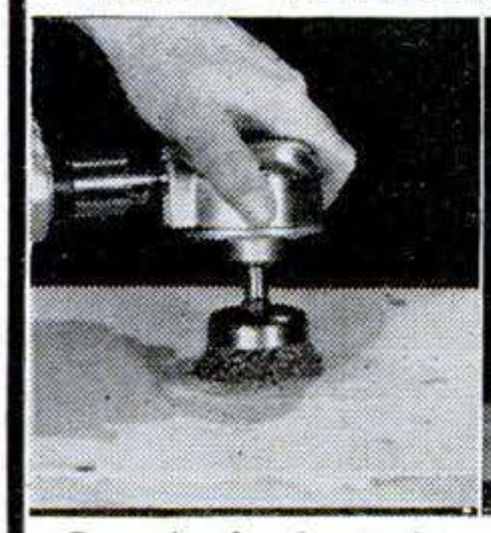


You polish and sand faster, easier — do beautiful, *professional* work—with this amazing new attachment for your hand drill. And it more than pays for itself *the very first time* you polish and sand your car, floors, woodwork, furniture.

The Bull Buffer fits any chuck on an electric drill (or flexible shaft). It's the only buffer you can turn *in a complete circle* while you hold your hand drill stationary. Reaches all curved and flat surfaces. It's packed with power, built of lifetime materials and *guaranteed*.

If your dealer doesn't stock, send cash, check, or money order for your Bull Buffer, complete as pictured below..... **$9.95**

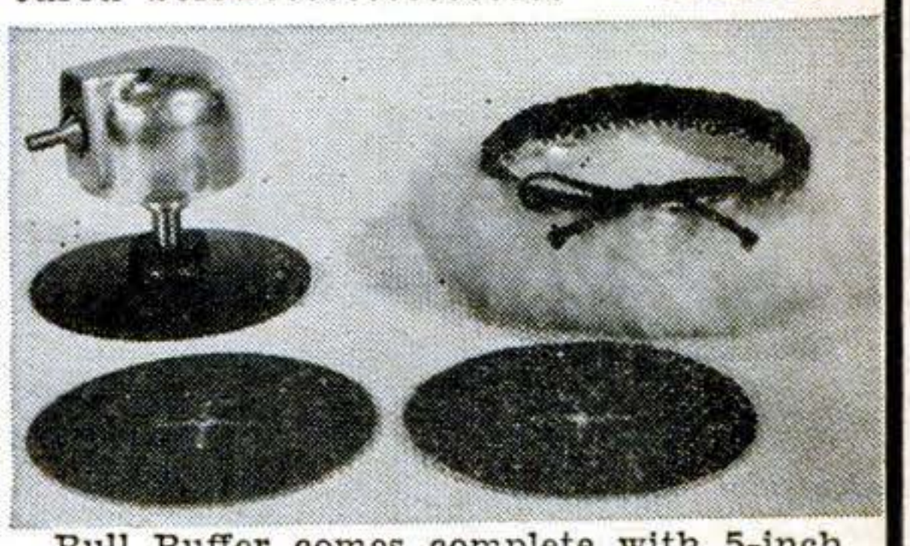
ORDER THESE ACCESSORIES FOR YOUR BULL BUFFER:



Cup wire brush attachment for removing paint from that hard-to-scrape surface, **$1.75**

Jacobs key chuck increases 1/4" drill to 1/2" capacity—reduces speed, increases power. **$5.00**

Bull Buffer car cleaner	$ .50
Bull Buffer car polish	1.00
Extra sheepskin bonnet	1.25
Extra sanding discs (000-00-0-1-2½-3-4) ..	.10
½" Jacobs No. 6425 key chuck (see photo) ..	5.00
2½" cup wire brush (see photo)	1.75



Bull Buffer comes complete with 5-inch rubber disc, sheepskin bonnet, and 2 sanding discs, only **$9.95**.

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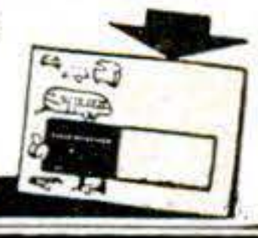

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DESIGNED TO DO HIGH GRADE WELDING inexpensively—Maintenance Men, Farmers, Mechanics, Machine Shops, Foundries, Auto, General Repair and Job Welding Shops, all using the **DYNAMIC** find it so indispensable and useful that they can not afford to be without it. **Works on Iron, Steel, Brass, Bronze and Other Metals.** Has 8 metallic and carbon arc heat stages. Does work you would think only possible with a larger, more expensive machine.

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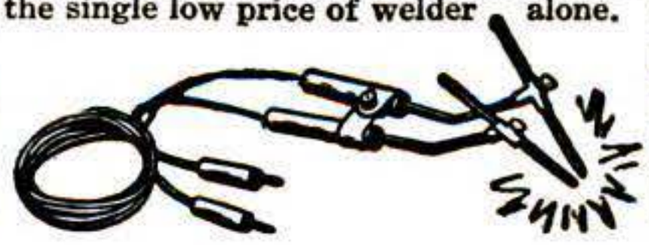

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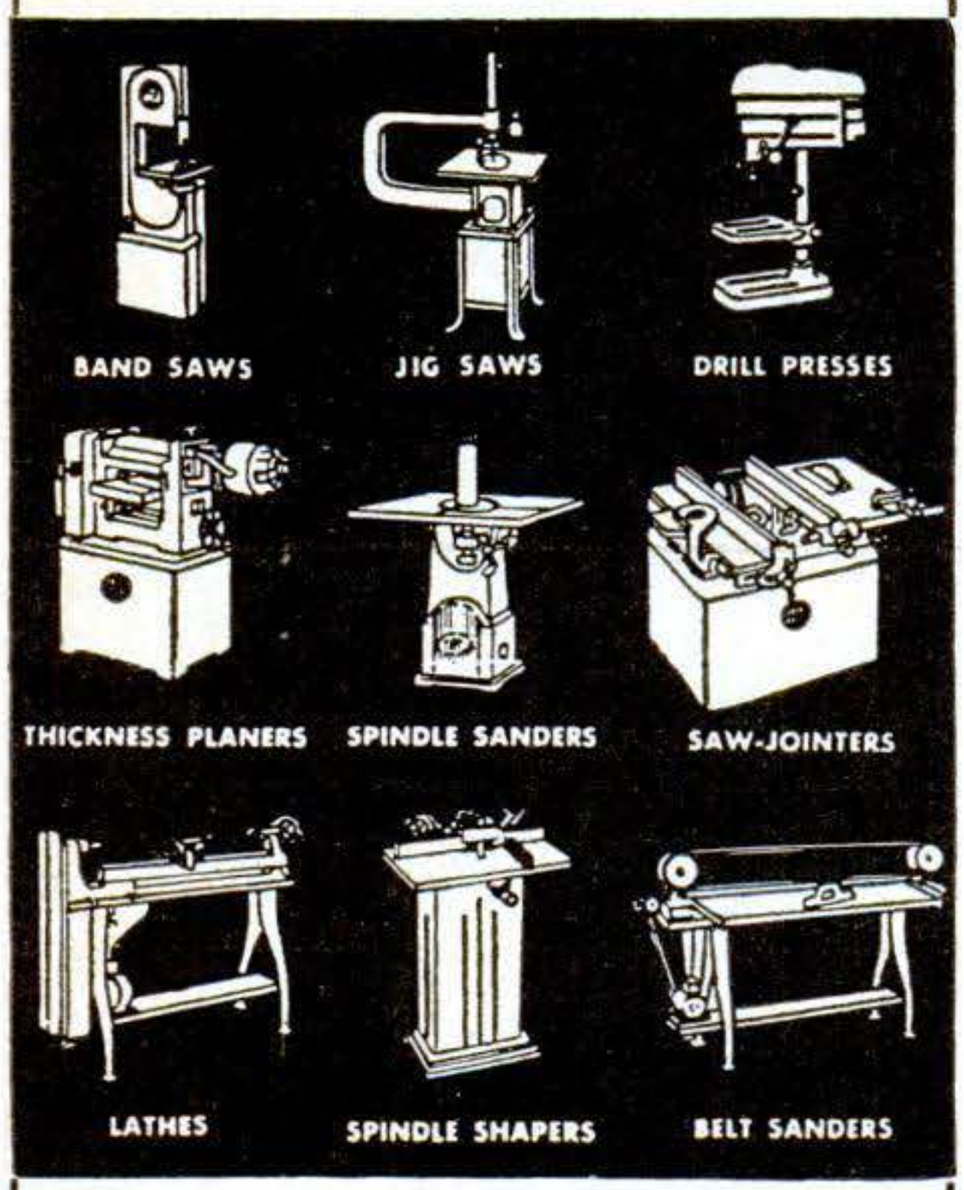

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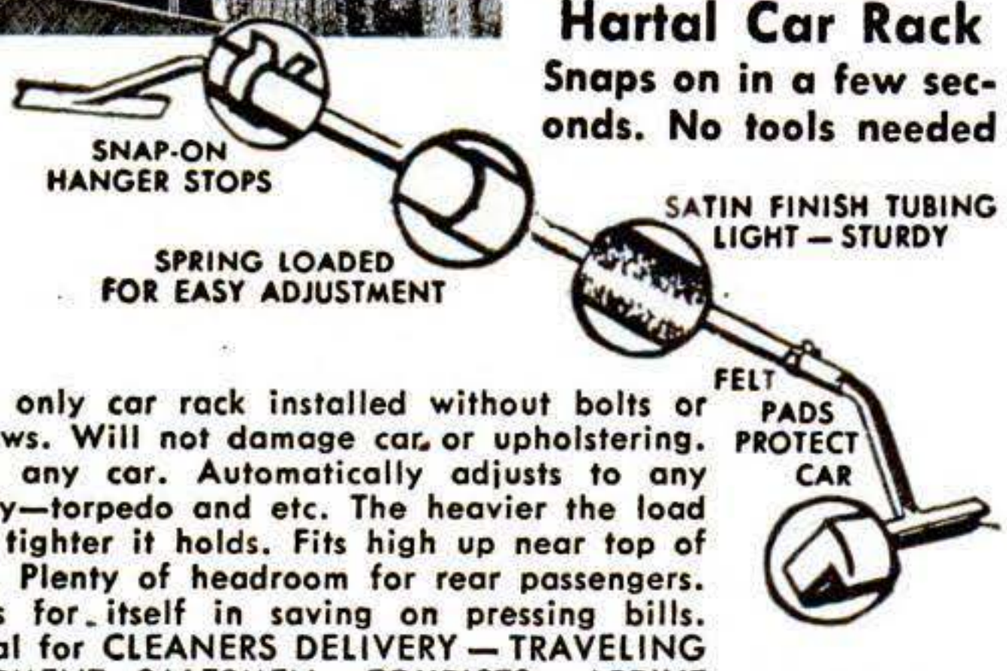
Hartal Car Rack

Snaps on in a few seconds. No tools needed



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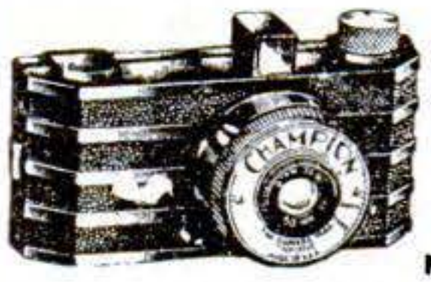

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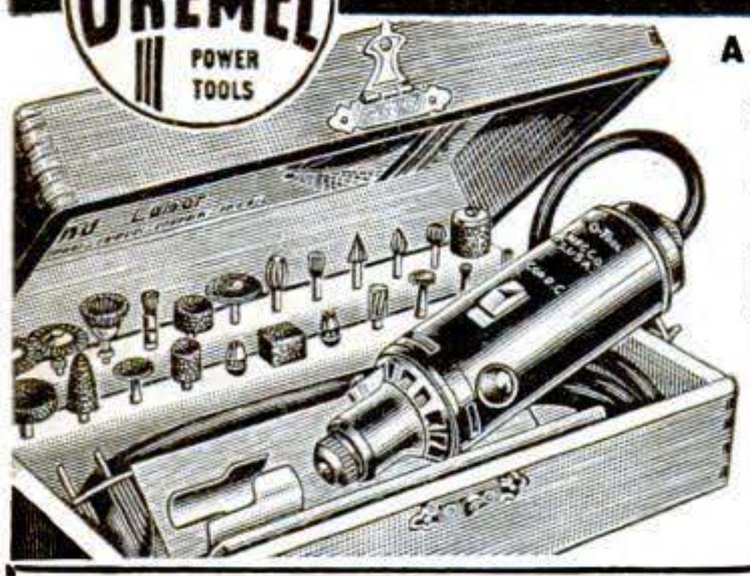

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(Less Moto-Tool)

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FIXES FENDERS AND BODIES LIKE NEW

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☐ Send Postpaid, Full Payment of $. . . . (check or M.O.) enclosed
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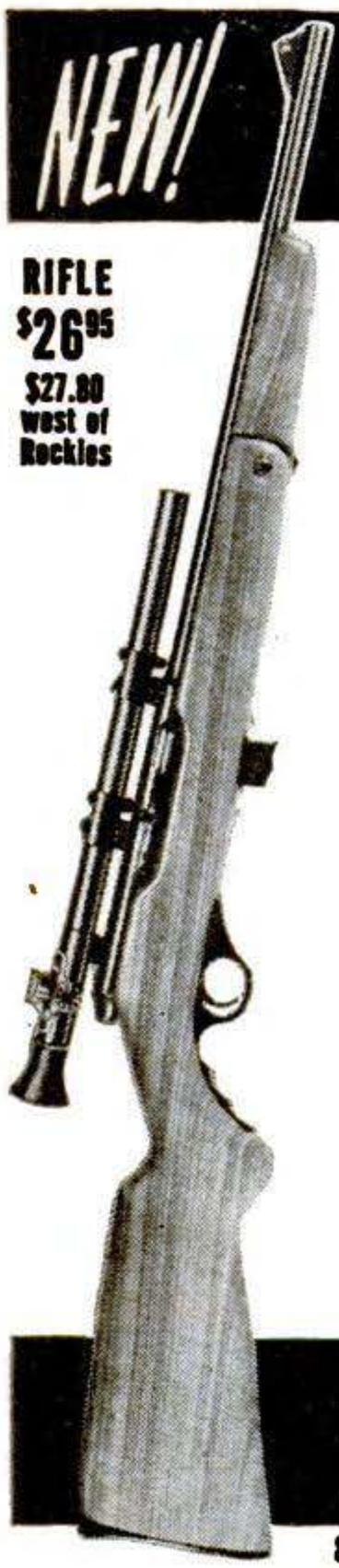

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In prone shooting fore-end gives helpful ground support.

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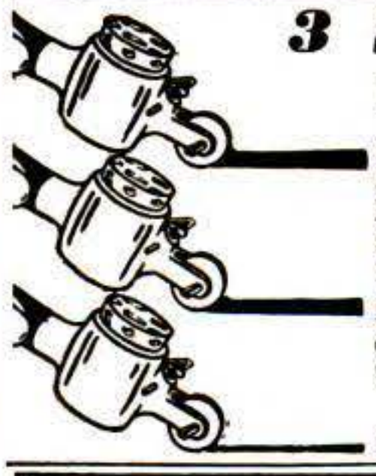

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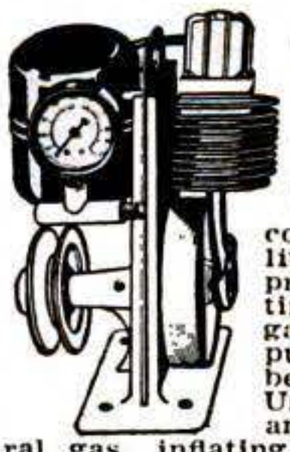

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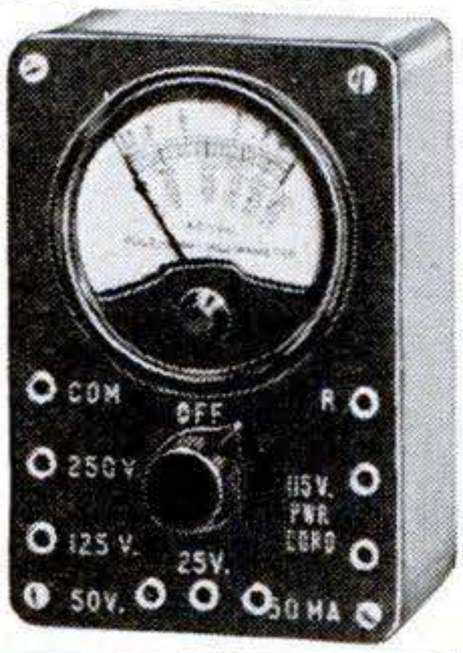

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Specifications of the AC-DC Model Volt-Ohm-Milliammeter:

AC Volts—0-25,50,125,250
DC Volts—0-25,50,125,250
Milliamperes AC—0 to 50
DC Milliamperes—0 to 50
Ohms Full Scale—100,000
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Total Price, prepaid anywhere in the USA—**$7.00**

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This brand new 15 tube transmitter-receiver was designed for mobile service on 12 volts, and will operate in the "Citizens' Band," where no govt. license to transmit is necessary. It's a cinch for any radioman or amateur to connect this unit for 110 VAC operation by following the instructions and diagrams supplied, which cover numerous applications, including television. For those intending to use on car or boat, a new dynamotor, exactly as originally supplied, costs only $15.00. Don't fail to write for **FREE** descriptive bulletin. RT 1248 transceivers only **$29.95 each,** or **two for $53.90.**

TERRIFIC VALUE

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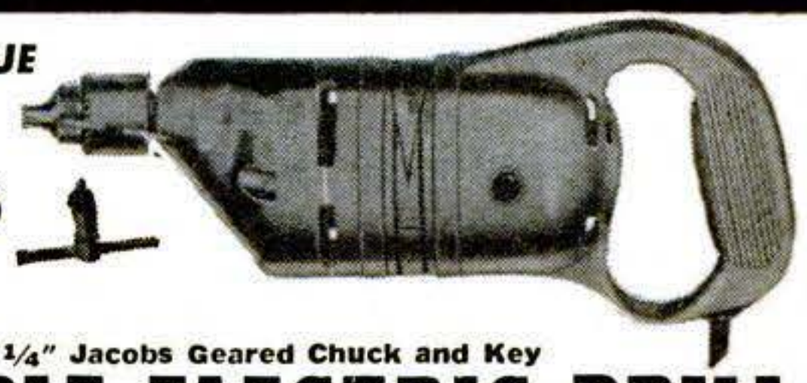
$19.95



Equipped with ¼" Jacobs Geared Chuck and Key

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(Sold at less than established factory price so we cannot mention brand name)

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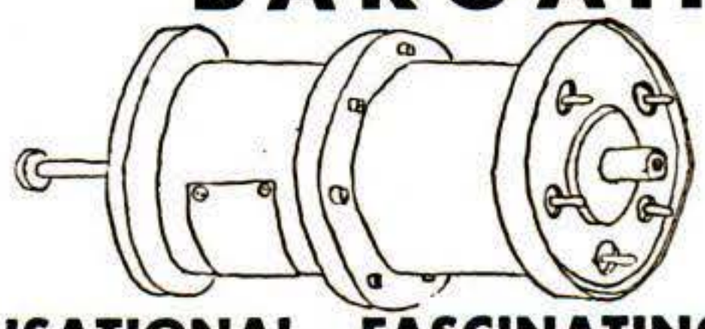
Full refund (you pay transportation) if not pleased with drill after trial.

$9.95 *TAKES ALL THREE* BIG BARGAINS



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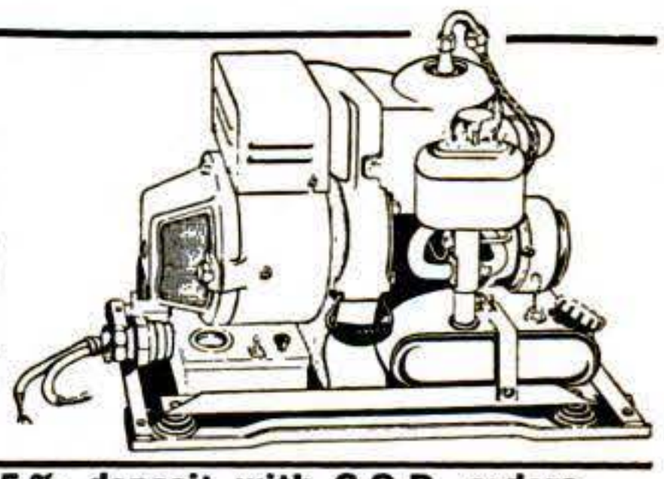
PE-109 32-VOLT DIRECT CURRENT POWER PLANT



This power plant consists of a gasoline engine that is direct-coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. **The price of this power plant is only $58.95.** We can also supply a converter that will supply 110V AC from the above unit or from any 16-32V DC source for **$12.95.**

(Due to the fact that the PE-109 comes to us sealed in heavy steel strapped govt. cases we are unable to determine whether the individual units are new or used or what the condition is if used, and consequently must sell them as is. In general, they represent a terrific bargain.)

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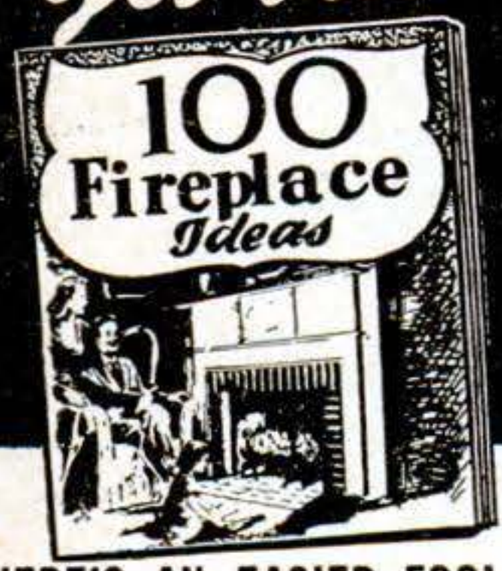

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or Camp

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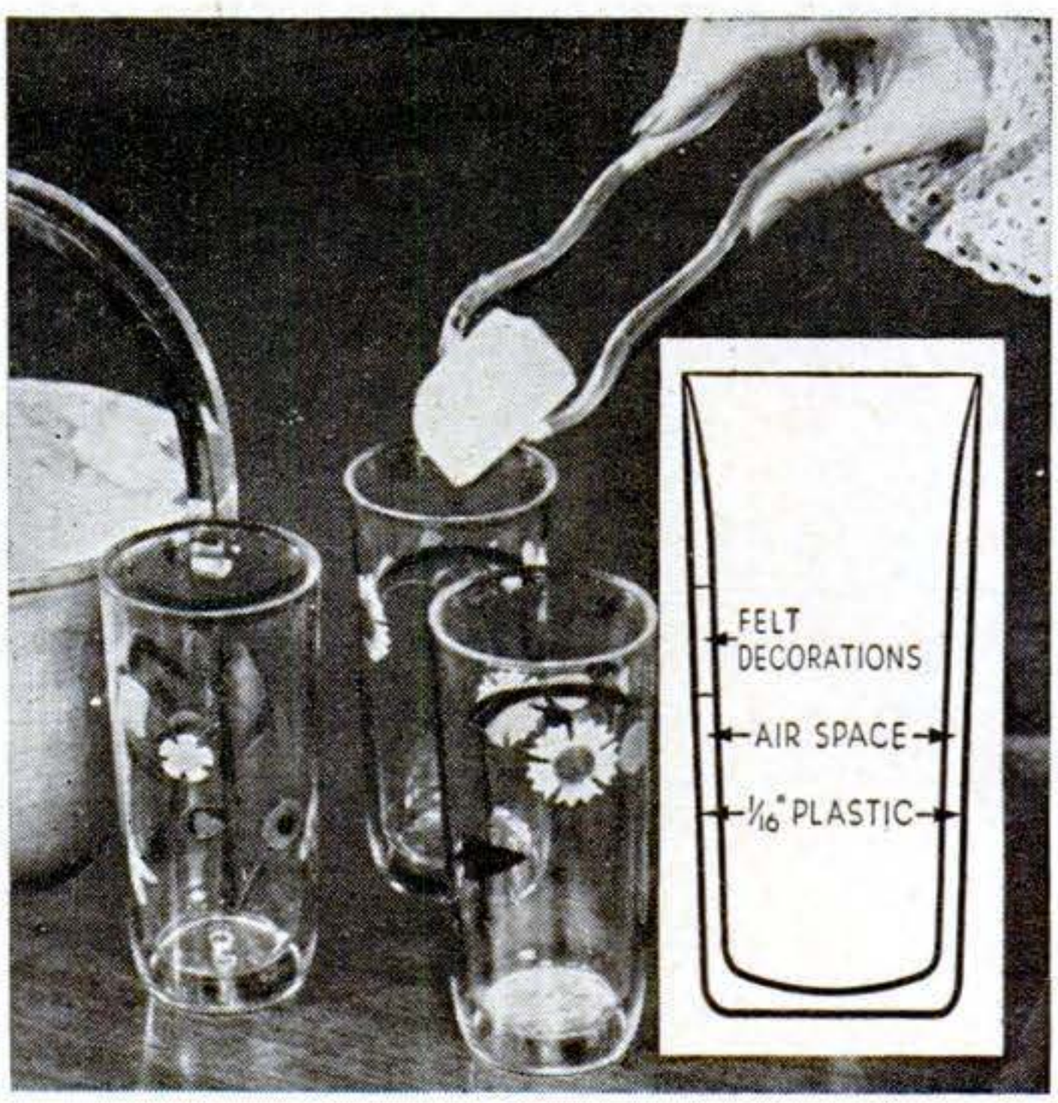
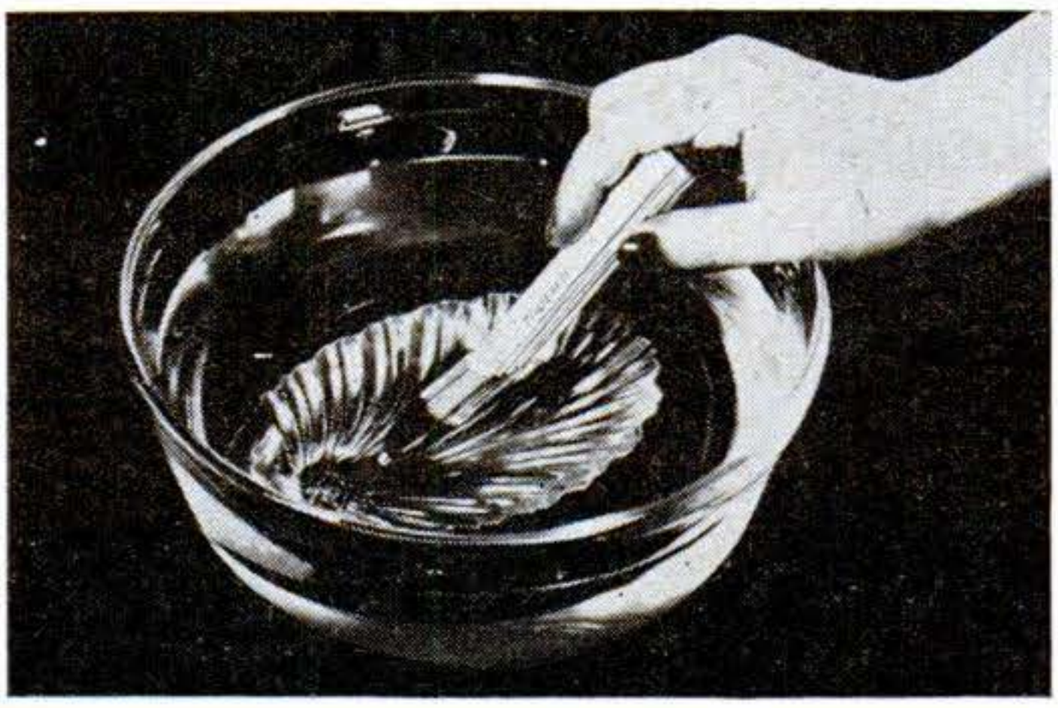


Double-Walled Tumblers. These new iced-drink glasses of clear plastic are comfortable to handle as well as decorative, according to the maker, the Detroit Macoid Corp., Detroit. The air space acts as an insulator, preventing condensation on the outer surface. Sparkling and virtually unbreakable, the tumblers are enhanced by bright-colored felt inserts in the air space.



Electricity Cleans Silver. This gadget removes tarnish by electrolytic action, as in the familiar aluminum-and-soda method. But Touch-O ⓣ uses current from a single flashlight cell for speedy cleaning on contact of tarnished silver spoons and other small objects. Larger pieces take longer. Lux Industries, Buffalo, N. Y., is the maker.

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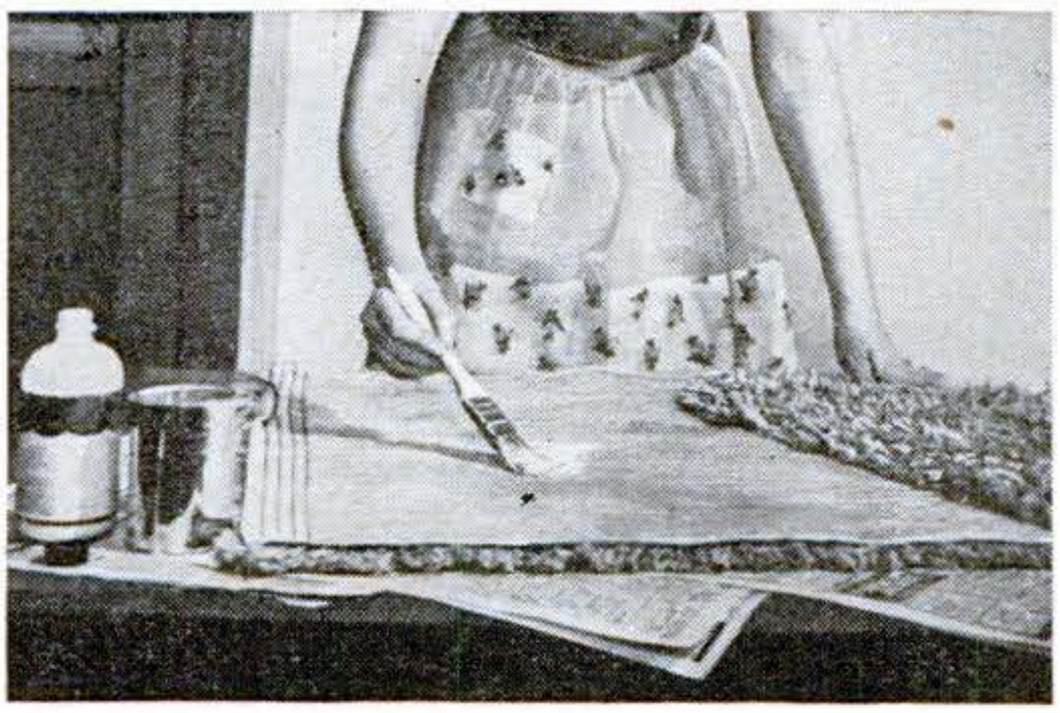
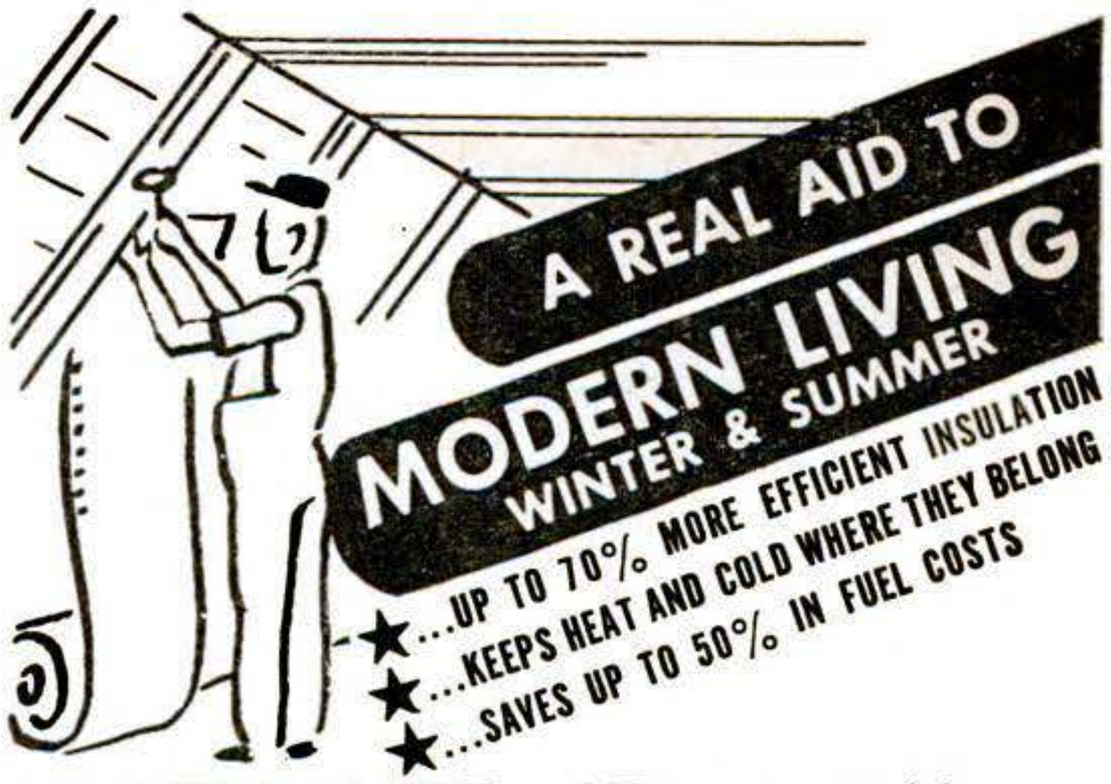
Modern Living

Spring Holds Spices. Cans or boxes of seasonings are held in place on this metal rack by a coil spring. The holder is designed for the inner side of a cabinet door, but the makers, B and D Associates, of Rochester, N. Y., suggest it is equally useful in the bathroom for bottles or in the shop to hold boxes of tacks or nails. Containers in the rack are easily identified and shelf space is saved.



Rubber Backs Rugs. Rugback Ⓣ, a United States Rubber Co. development, forms a tough, flexible, transparent rubber film when painted on the back of a rug. The company says the liquid dries in an hour and that it prevents rugs from slipping yet does not stick them to the floor. The price is $1 a pint, enough to cover about 40 sq. ft.



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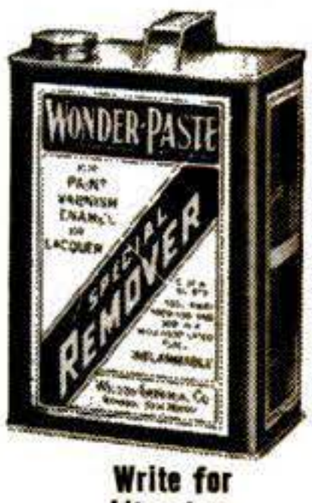

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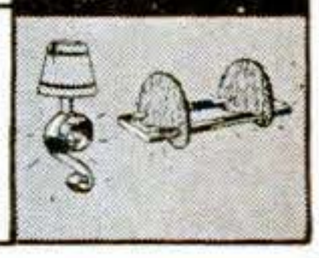

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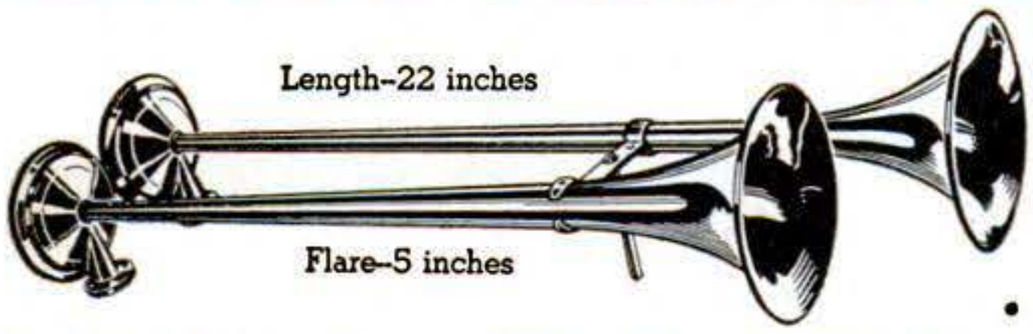

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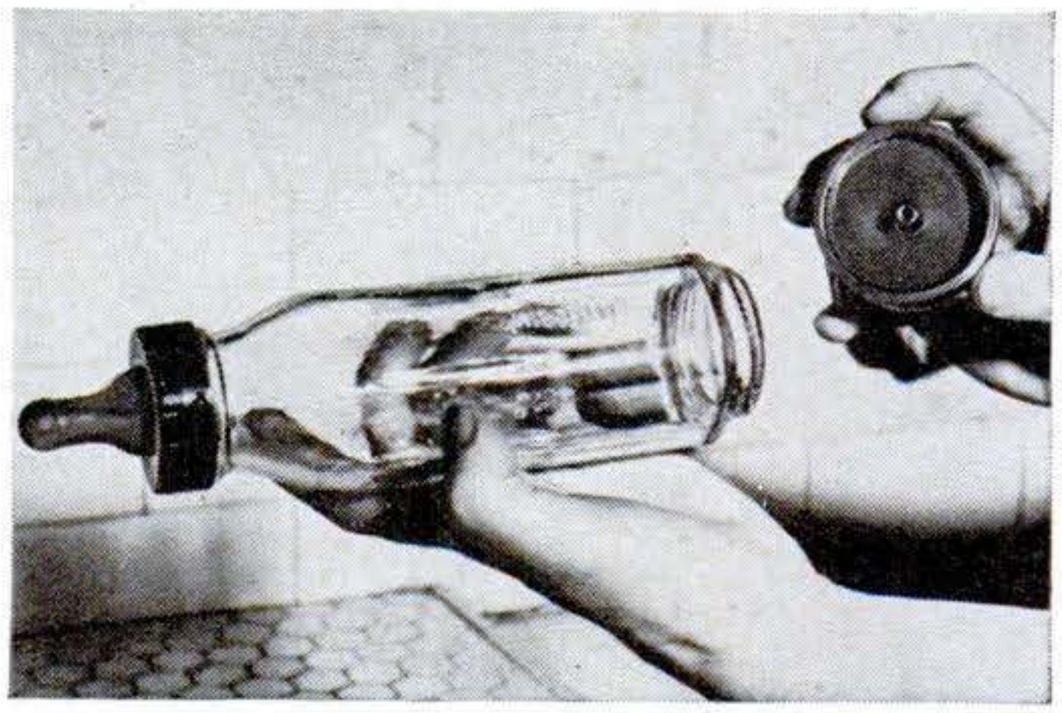
Aids to Modern Living

Hot Dogs Cooked Electrically. Preparing frankfurters at the table is simple with this small plastic cooker. After the dogs are pressed on the carbon electrode prongs, current is switched on automatically by closing the lid. The current flows through the frankfurters, which offer enough resistance to cook in one to two minutes. Triar, Inc., of Detroit, makes the cooker. Salts and moisture within the frankfurters are sufficiently conductive to carry a heating current.



Baby Bottle Has Air Valve. The No-Burp Nursing Bottle Ⓣ, offered by Baby Products, Inc., of Los Angeles, has an air intake valve built into the removable plastic base, minimizing the amount of air a baby swallows when feeding. The valve permits air to enter the bottle to replace the milk drawn from it by the baby.

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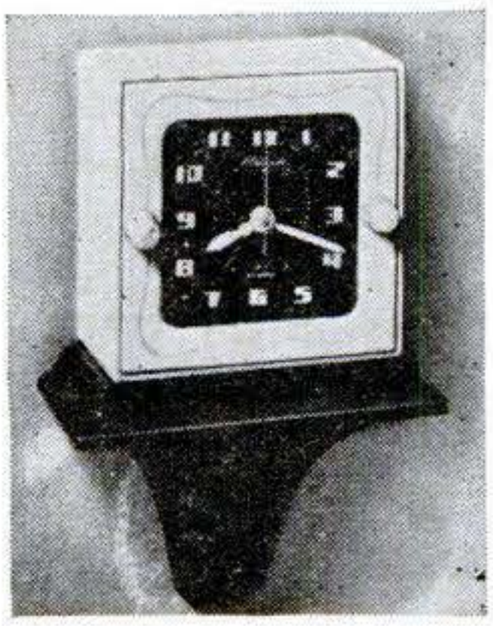
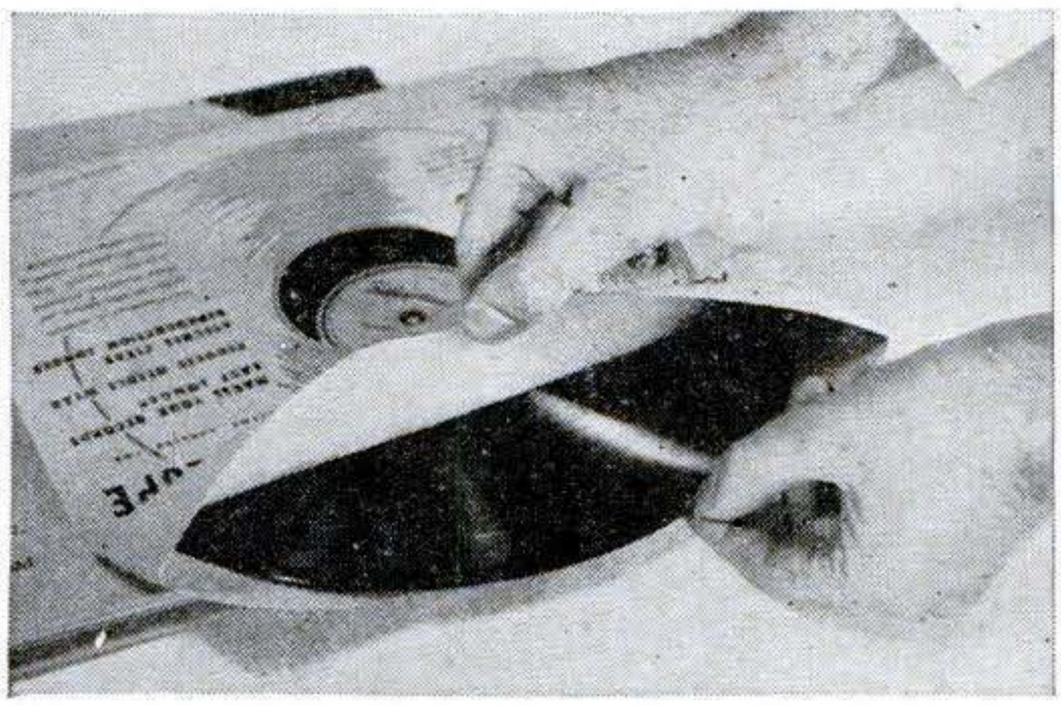
Wind Gauge Fits Pocket. The Windikator Ⓣ shows wind direction and velocity, weighs less than 2 oz., is nonmagnetic, and corrosion resistant. The H. M. Sawyer and Son Co., of Cambridge, Mass., manufactures two models—one registering winds from 5 to 30 m.p.h. and the other from 10 to 50 m.p.h. The company guarantees the accuracy to plus or minus 5 percent.

Pin-Up Alarm Clock. A combination wall and table electric clock, the Pinwall Ⓣ has all controls on the front and may be used with or without the bracket. The clock, made by Telechron, Inc., of Ashland, Mass., is 2¾″ by 4¾″ by 7½″ with a 6′ cord attached. The case is ivory plastic set on a brown plastic base. The metal dial has ivory-colored characters on brown. Price: $7.95.





Lined Record Envelope. A soft, velvetlike lining in these new record envelopes is said to protect records and keep them free of dust and grit. The maker, Ever-Kleen Sales Co., of San Diego, Calif., recommends that a record be twirled a couple of times in the envelope to take dust out of the grooves before playing it.

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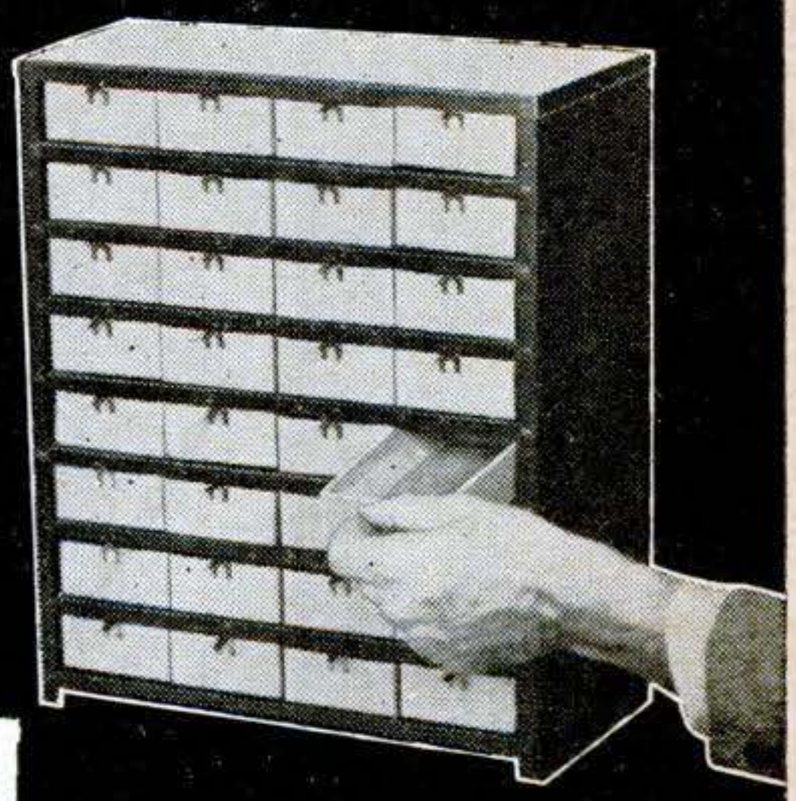

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for home or shop, the handy way to keep small parts, washers, nuts, bolts, nails, screws, etc.

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FROM: Editor

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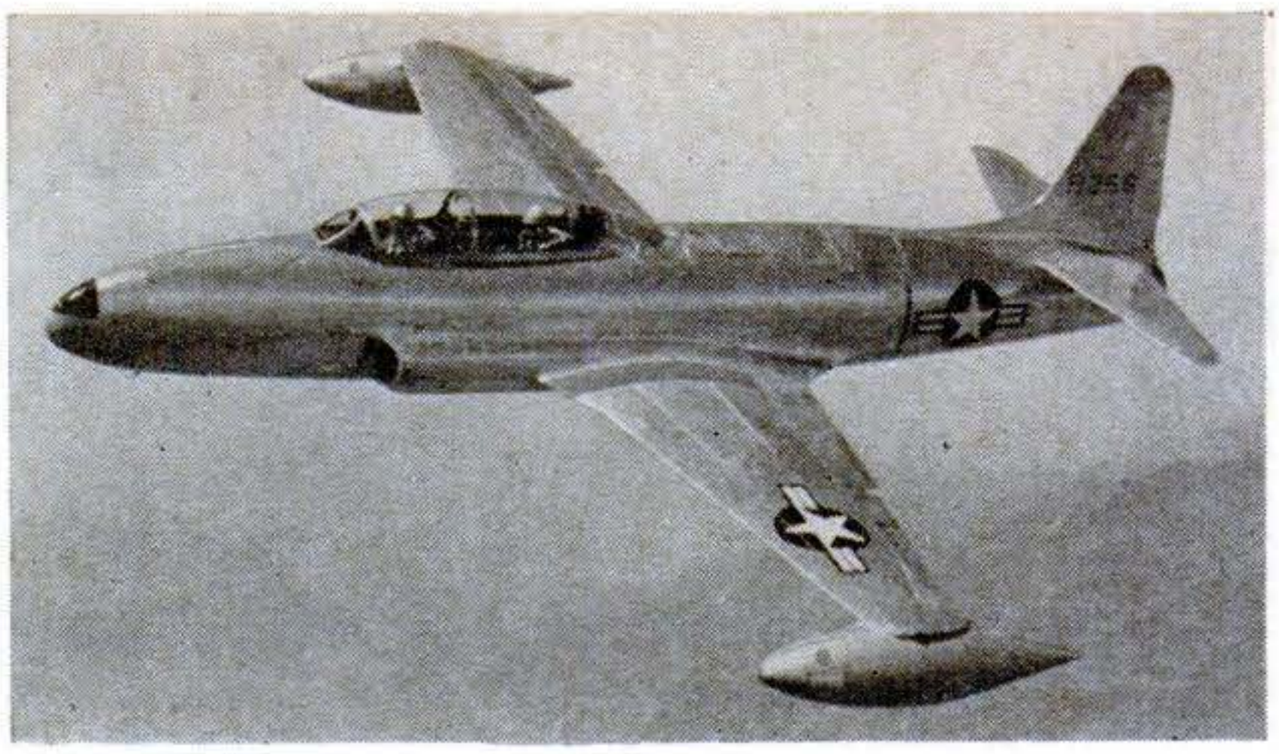

WHEN I started to climb into the plane, Tony LeVier, the pilot, asked, "Are you nervous?"

"No," I said. I wasn't, I suppose, because LeVier is one of the world's great airmen. I had confidence in him.

We were about to take off in the Lockheed TF-80C Shooting Star jet trainer. By the luck of the draw at Andrews Field, near Washington, D. C., I was to be one of a handful of civilians and the first professional writer in the United States to fly more than 500 miles an hour. My fellow writers, invited to make the flight by the U. S. Air Force, stood about watching as I took one last tug at my crash helmet.

Then I was in the rear cockpit; the long, plastic canopy came down, and we were taxiing out to the runway to the muttering of gases in the plane's tailpipe.

We were no sooner squared away than the throttle was opened. Unlike a reciprocating engine, a jet needs no warmup. The pressure on my back as the plane accelerated was no more than that in a conventional plane.

We made knots fast. The airspeed needle wound up. We came unstuck. We were airborne. My first reaction was, "How simple!" The familiar vibration associated with propeller aircraft was almost absent. So was the noise. The sensation was pleasant. LeVier was clocking 170 miles an hour as we climbed.

At 2,000 feet he levelled off. "Okay?" said LeVier through the interphone.

"Okay," I replied. I was. This was without question the most exhilarating experience I had ever had in an airplane.

"How does it feel?"

"It's the nearest thing to riding in a glider I've ever known," I said. And it was. Most of the sound reaching my ears appeared to be the swish of air caressing the long, sleek fuselage. It was like being suspended in space. There was, of course, no sensation of speed as the air speed built up. We were too far off the ground to have anything to compare our speed with.

The nose came up. We were climbing again. It seemed only a moment until we were at 10,000 feet.

"Want to feel some Gs?" asked my pilot.

We banked. The great speed in the turn crunched me down in my seat. We did an aileron roll. The maneuver was over before I knew it. We dived.

"I'm putting on the dive brakes," said LeVier.

It was a near-jolt as the brakes took hold. Down we went again, brakes retracted. My ears cracked as we levelled off on the deck, circled, and raced across the field a hundred feet above the runway.

The clock said 550 miles an hour.

I could only think, "Whew!" Off the wing I glimpsed the little knot of people watching from the apron. Then they were gone and the plane was climbing to make its approach for the landing.

LeVier sat her down at 110 miles an hour far more softly than I ever have put down the little putt-putts that I fly myself.

When we had come to a stop on the apron and I had unfastened my seat belt and shoulder harness, I discovered it was quite a job getting over the side of the cockpit and onto the wing root. The crowd was watching.

"Legs must have gone to sleep," I explained.

A man couldn't admit that his knees were weak.

Devoy Francis

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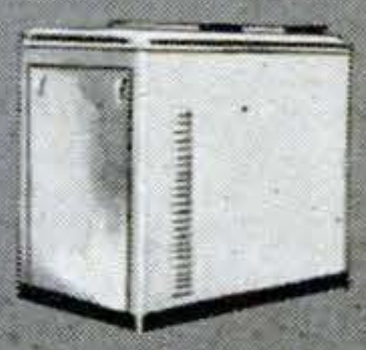

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Mail coupon for complete information or see local distributor. He is listed under "Machine Tools" or "Lathes" in your classified telephone book.

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DISTANCES BETWEEN CENTERS—16" to 34"

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MAXIMUM COLLET CAPACITY—½ inch

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Bench Model, $129.30
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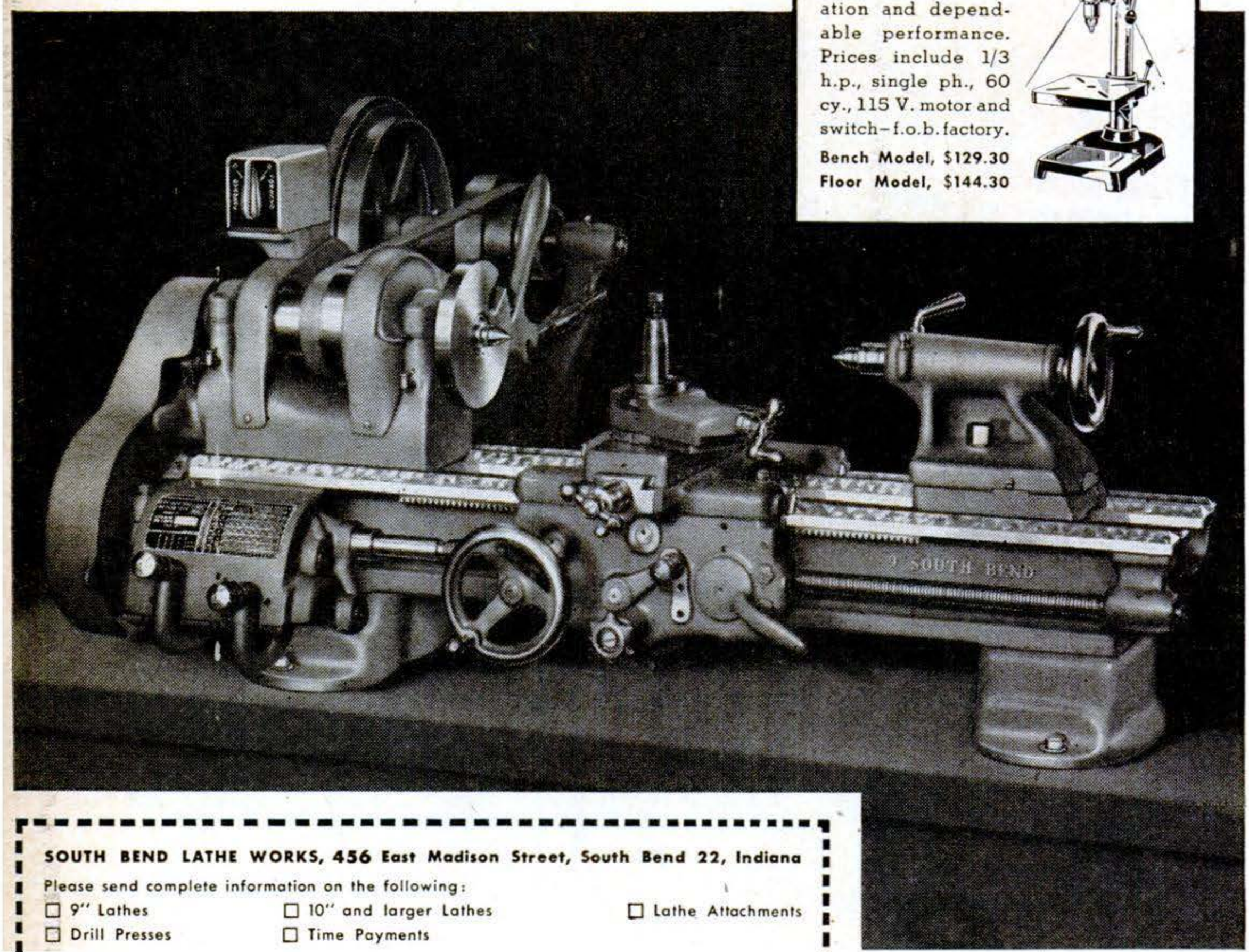

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Turn to this comprehensive HANDBOOK with confidence. You will find its helpful pages crammed with the latest, most efficient and workmanlike ways of doing every kind of job about the home and in the home workshop. Carpentry, metal work, electrical work, plumbing, masonry, painting and decorating—all explained by master craftsmen. The most detailed information about how to choose, repair, and apply the right materials in the right places.

PAINTING & DECORATING

Principles of paint mixing, formulas, and how to obtain any desired hue. Full directions for selection and care of brushes and other equipment. How to calculate amount of paint required, and best methods of applying to wood, metal, brick, concrete, stone, stucco, plaster. Exterior house painting—interior house painting—choice of color schemes. Complete directions, fully illustrated, for obtaining decorative effects—stippling, mottling, texturing, stenciling, striping, etc. Methods of finishing with stain, shellac, varnish, and wax. Detailed, step-by-step instructions for wallpapering. How to refinish an auto quickly, easily, and inexpensively.

WOODWORKING

The many varieties of wood and their relative merits, working qualities, and uses. Plywoods, veneers, and wood substitutes—how to choose the materials best suited for the job. Sizes, types and functions of all carpentry tools—how to use, sharpen, and adjust them. All the basic operations and processes of woodworking—everything from how to avoid warping to full directions for cutting each of the common joints. Wood turning—the different cuts, roughing, facing, sanding, and finishing; drilling, boring, mortising, spinning, polishing. Hundreds or repair jobs and new projects are fully explained with diagrams and every fact you need to get the best results.

PLUMBING

The various kinds of pipe, pipe fittings, valves, and fixtures. All the common plumbing tools—types, sizes, functions, and how to use them. How to cut, ream, thread, and assemble iron and brass pipe. How to connect copper tubing and make lead joints. The technique of pipe fitting, and the proper sequence of steps in assembling a piping system. Household plumbing projects—installing a hot-water heater, radiator, and various other units. How to drain a plumbing system when closing the house for the winter. How to fix leaky faucets, and repair or replace a faulty section of pipe.

METALWORKING

Complete information about all the common metals, and the alloys—wrought iron, cast iron, steel, German silver, pewter, the brasses and bronzes, solders and babbitts—when to use, how to use, and how to work them. Hand tools and machine tools—their specific purposes, sizes, and the most detailed instructions for their use. Hints, ideas, and "tricks of the trade." How to use the engine lathe. Metal jobs and projects for home and shop, complete with bill of material, equipment needed, and a fully illustrated account of every step in the work.

MASONRY

Answers every practical question about concrete, plastering, stucco, brickwork, concrete-block and glass-block construction. Describes all tools, and just how to use them. How to specify materials and estimate quantities. How to build forms; mix concrete, color it, make it watertight, finish it off; how to build walls, floors, steps. Everything about plastering—from small repairs to doing entire rooms. Complete instructions for stuccoing—reinforcing, methods of applying different coats, and how to obtain various decorative finishes. Kinds of brick—handling and laying. Mixing and coloring mortar. Material charts. Types of construction. Various bonds. Forming cross joints. Fireplace construction. Working with concrete blocks—building the wall, corner construction. Kinds and sizes of glass blocks. Glass-block construction—mortar, full-mortar joints, set-in-wood construction.

ELECTRICAL WORK

Practical information about every electrical job the home mechanic may undertake around the house or in the home workshop. Principles of electricity—

Yes, **this big-value book, "The Roof Over Your Head", is absolutely free. It's yours to keep, a gift from us. Profusely illustrated and jam-packed with useful information, this practical guide to home building and planning contains facts, figures, photos and sketches, *plus* eight basic home plans and a comprehensive cost chart that permits you to select a home that fits your wants, your needs, and your pocketbook. Accept this helpful book with our compliments—it can save you time, money and disappointments—and you get it absolutely FREE. Just cut out and mail this postcard →**

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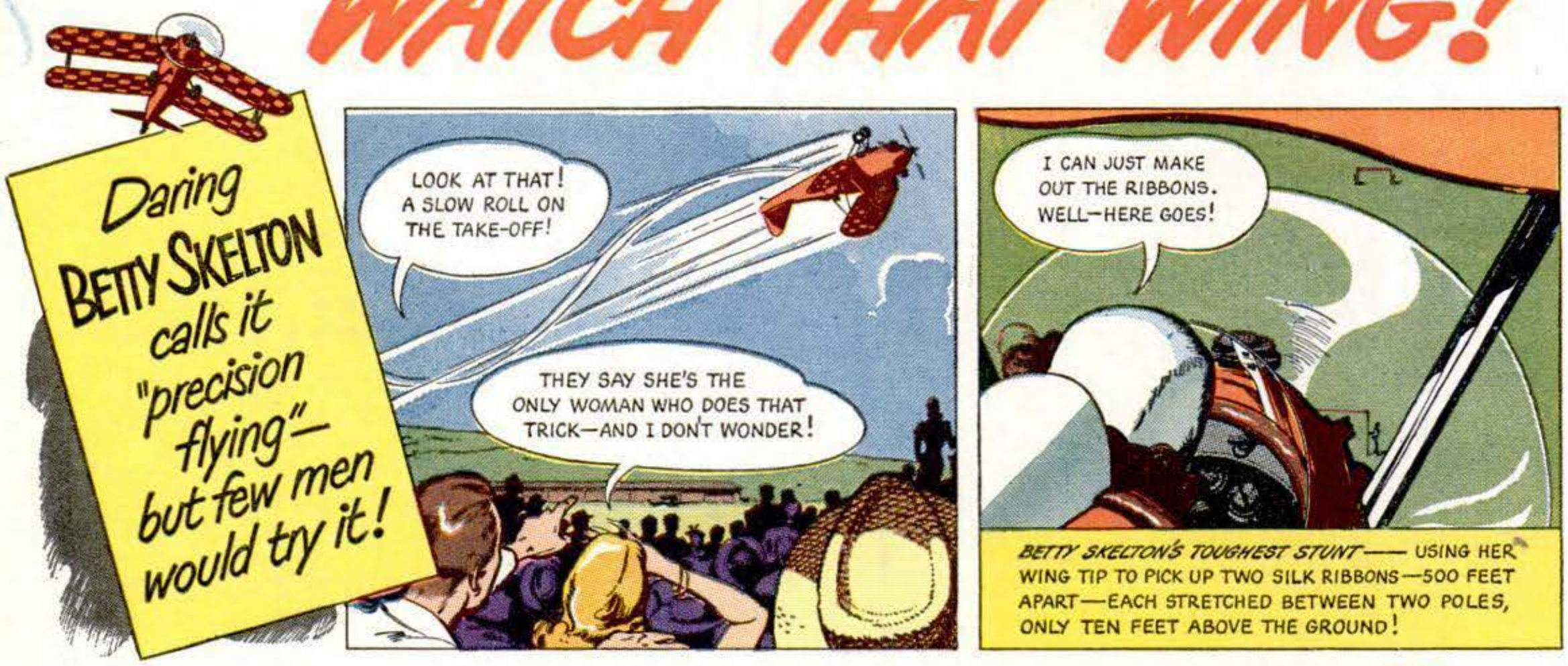

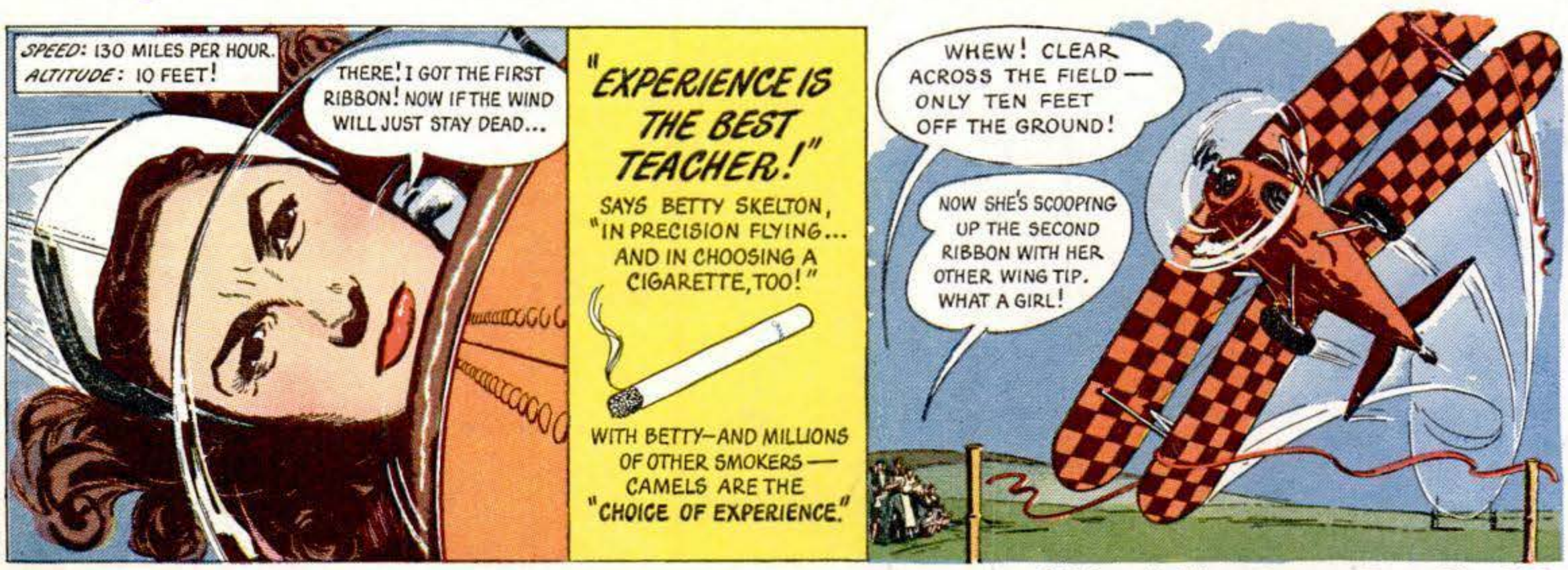

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Three nationally known independent research organizations asked 113,597 doctors to name the cigarette they smoked. More doctors named Camel than any other brand.

MORE PEOPLE ARE SMOKING CAMELS THAN EVER BEFORE

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